ENGINEERING NEWS

DURING the week violent storms have occurred in Pennsylvania, Delaware and Dakota, causing much damage to buildings. Much damage has also been done by lightning. Washouts have occurred on the Lebanon Valley Railroad between Richland and Myerstown, Pa., the Burlington & Missouri River Railroad, caused by a water spout, on the Northern Pacific Railroad and the St. Paul, Minneapolis & Manitoba Railroad; at Grand Forks, Dak., a tornado occurred June 15 and a train on the latter road was blown from the track. A tornado did much damage at Wilmington, Del., on June 22 and caused the death of several persons. An earthquake shock was felt at Summerville and Charleston, S. C., on June 19.

THE Philadelphia rapid transit scheme, referred to last week, has been reported upon favorably by the railroad committee of the Select Council of that city. The committee, however, recommend that the routes be approved by the Mayor and Board of Highways, and extend the time of construction, limit the fares to 5 cents and provide that the city shall receive 2 per cent. of the gross receipts. The whole question will have early consideration by Councils.

WORK on the Poughkeepsie bridge is progressing quite rapidly. All the river piers are under way. Masonry is going on at pier No. 2, concreting at No. 3, and building, dredging and weighting at Nos. 4 and 5. The tower for No. 6 is erected, the bent on the east anchorage is nearly finished, and the raising of the east shore arm is about to begin. The falseworks for it have a very impressive appearance, and give a vivid idea of the magnitude of the structure, which will be one of the grandest in the world.

ON June 3 the German Emperor inaugurated the canal which is to connect the German Ocean with the Baltic Sea. At the risk of repeating matter already noted we again give the salient features of this enterprise. The canal is to be 61 miles long and the estimated cost is $39,000,000. The cross-section adopted is 196 ft. 10½ in. wide at the water surface, 85 ft. 3½ in. at the bottom, and the normal depth is to be 27 ft. 10 in. This normal section is thus 3,934¼ sq. ft., or six times the cross-section of displacement of the largest steamship expected in the canal. The annual cost of maintenance is estimated 2,000,000 *marks*, and the government calculates that the canal will be used annually by about 18,000 vessels, with an aggregate tonnage of 5,500,000, on which an average transit tax of 18 cts. per registered ton will be imposed, yielding a total revenue of $1,031,250. The route of vessels to and from the Baltic will be shortened by about 237 sea miles. The work is to be parcelled out among a number of contractors.

THE towing interest was greatly grieved by the partial wreck of a steamer against one of the caissons of the Poughkeepsie bridge, last week and no doubt the incident will be worked for all it is worth. Other partial catastrophes have already occurred and in one case at least, we are informed from a disinterested source, by the apparent deliberate intent of the pilots.

It is claimed that at certain stages of the tide it is difficult to handle a tow successfully between the piers, and it must be admitted that the tows are somewhat unwieldy things to handle, and that the piers and caissons may make certain changes in the current which must be studied and understood before the passage of tows will be entirely convenient; but that it is not possible to steer the navigation of the Hudson river through a series of 520 ft. clear spans without any serious annoyances of a permanent nature is a little too thin a claim to those who know what is done in far more exacting localities.

Mr. GORDON H. NOTT, lately proposed to drain Chicago by a 26 ft. tunnel 30 miles long; commencing at a point 40 ft. below the lake, and ending just east of Joliet. At the latter place he would have 300 acres of settling basins. Mr. NOTT estimates that "the tunnel could be completed in 18 months," and would cost $9,127,910. He thinks that the saving from decreased pumpage, as compared with the open canal plan, would amount to $978,000 per annum, as this tunnel would only require 150,000,000 instead of 540,000,000 galls. of water per day. His plan, however, contemplates an entire new system of sewerage with a fall of 4 ft. per mile.

THE Legislature of New York has passed a very wise act banishing the car stove after May 1, 1888, under penalty of $1,000 and $100 per day for each offending car after that date. The literal wording of the law only forbids fires inside the car, and will permit fires beneath the car, but the effect will probably be to exclude these also. It is permitted to retain the present stoves to heat the cars when standing still only, and to use approved ranges in dining cars, and roads less than 50 miles long are excepted.

This action will almost surely be imitated by the States which have not done so already, and a great and needed reform will have been quietly and rapidly accomplished. When this journal took up the question with some emphasis only four or five months since, the great majority of the more prominent railway officials were publicly or privately, declaring that heating from the locomotive was not possible. There are few or none who would have the temerity to assert the same thing to-day. The history of engineering has few instances of such rapid progress of a great reform involving quite a large expenditure.

WE are pleased to learn that the Nicaragua canal syndicate have just completed its payments under the Nicaraguan concession by handing over to the agents of that government in this city the sum of $100,000 in American gold. This is all that is necessary to confirm the contract, under which 2½ years are allowed for completing the necessary surveys, with one year more for beginning construction. The concession carries with it a grant of 1,000,000 acres of land and other valuable privileges. It is proposed by the syndicate to send out several parties of engineers as soon as the rainy season is ended to make a careful resurvey and location of the line, after doing which, if there is no failure in the contemplated arrangements for raising money, which we are told bid fair to be concluded very soon, construction will immediately begin. The office of the syndicate is at 36 Broad street, Room 55. It can hardly be that the above payment would have been made unless there had been some definite expectation at least of being able to proceed with actual construction.

Superintendent of Motive Power WALLACE, of the Philadelphia, Wilmington and Baltimore Rd., has lately brought to a successful conclusion an interesting trial to determine how many miles a passenger locomotive, properly cared for, could run without detriment in a month of thirty-one days. Last summer a Pennsylvania Railroad engine, during one month, made the round trip of the Middle Division (Harrisburg to Altoona) twice daily, covering, during that time, 16,368 miles, the longest distance ever covered in a month by a single locomotive up to that time. On the 30th of last April, Superintendent WALLACE started engine No. 317 from Washington to Philadelphia at 3 A. M. May 31, 17,112 miles had been recorded, and the record beaten by 744 miles. No. 317 has 68-in. drivers, cylinders 18½ by 24 in., weighs 100,600 lbs. all told, the weight on the drivers being 67,800 lbs. The distance between Philadelphia and Washington is 138 miles, and "317" covers it four times every 24 hours, leaving Philadelphia at 7.20 A. M. and 4.30 P. M., and leaving Washington at 11 A. M. and 10 P. M. Four crews were employed daily on the engine, and the splendid mechanism has come out of the test in first-class condition. In addition to the 17,112 miles traveled with a train, No. 317 made 1 mile unattached at each end of each route, or 8 miles empty per diem. This for 31 days would make 248 miles to be added to the 17,112, or a total of 17,360 miles.

IT is announced that "plans for six car trains" over the Brooklyn bridge "will not be decided on till next winter," and that in the mean time the additional switch will be put in as proposed by Chief Engineer MARTIN, to enable four-car trains to be handled instead of three cars. As we have already suggested, this is obviously the proper thing to do, giving time, as it does, to think first and act afterwards—an opportunity which we trust will now be made good use of. Mr. MARTIN'S proposition was illustrated in our issue of June 4, in connection with the proposed six-car reciprocating system, which we found so seriously objectionable.

THE first goods train passed over the new Tay bridge on June 4. The bridge was to be officially opened on June 14; the first passenger train very properly carrying all the directors of the North British Railway Co.

The Tay bridge that fell in 1879 cost $1,750,000, while the present structure, estimated to cost $3,250,000, really cost very nearly $5,000,000. The contract was let to Messrs. ARROL & SON, of Glasgow, November, 1881, but work was not actually started until June, 1882. The new bridge has a total length of 10,780 ft.; with 86 piers, with spans varying from 68 to 245 ft. At the middle of the river the clear headway for vessels is 77 ft., or 11 ft. less than that of the old bridge. Most of the piers are founded on iron cylinders, those in the deepest water having a base diameter of 23 ft. and taper to 17 ft. The other pier cylinders range from 17 to 15 ft. in diameter. These cylinders have been sunk to an average depth of 30 ft. below the bed of the river, some of them being sunk 84 ft. below low-water mark. About 3¼ years were consumed in sinking these piers, and by order of the Board of Trade, each pier was tested by being loaded with from 1,248 to 2,500 tons of pig-iron according to diameter. From low-water to 18 in. above high-water, the shafts are continued in solid brickwork, and above this a course of granite surmounted by 7 ft. of blue brickwork. The girders of the bridge were erected and riveted on shore, then floated on barges, and lifted into place by hydraulic power. About 18,000 tons of iron and 10,000,000 brick were used in the work.

The most serious accident of the week, and in fact of several weeks, happened to the "Congressional Limited Express," from Washington to Philadelphia, on the afternoon of June 20, scalding one man to death and injuring ten or a dozen others. In was an oblique head collision—a rather rare class of accident (because the conditions rarely exist to make it possible) such as we had occasion to discuss in our issues of June 4 and 11 in connection with the proposed changes of the Brooklyn bridge, and resulting from the same conditions which it was proposed to introduce on the bridge, the running of a double track over a single track bridge by interlacing the rails. The accident has such interesting features that we have discussed it more fully elsewhere.

It deserves chronicling that the sound remnants of this wrecked train were whisked across New Jersey in 1 hour and 54 minutes, including stops aggregating 6 minutes. Allowing as much more for time lost in slowing this left 102 minutes for running 90 miles. "Several" stretches of 10 miles, it is stated, were run in 9 minutes. This deserves chronicling, not because it is unusual, but because it is only a little "more so" than the regular performance.

THE Strong duplex locomotive has been sent West in regular service to exhibit at the Master Mechanics' and Master Car Builders' Conventions at St. Paul and Minneapolis. This engine, it will be remembered, has a double corrugated firebox uniting in a single corrugated barrel beyond. It is stated to have made an excellent record on the Lehigh Valley.

VERY active efforts are now being made to relieve Buffalo streets of the ever increasing multitude of grade crossings. It is estimated that from $750,000 to $3,000,000 will be required to elevate the more important tracks.

THE manufacture of the A. H. EMERY testing machines has been transferred by the Yale & Towne Manufacturing Co. to WILLIAM SELLERS & Co., of Philadelphia.

AN endeavor is being made to induce the Cooke Locomotive Works to remove from Paterson, N. J., to Indianapolis or some other western town. Very liberal offers have been made, but as the Cooke works include some thirty buildings it is a rather serious undertaking.

EFFICIENCY OF CABLE ROADS.*

Its Variation with Length of Cable and Other Elements of the Construction.

BY JAMES A. SEDDON, MEM. OF ENG.'S CLUB OF ST. LOUIS.

(Read Feb. 2, 1887).

Concluded from page 393.

Our expression for P_2 is now K_2 (cable weight),

$$\text{or } P_2 = K_2 \text{ (weight per foot)} \times L \qquad (1)$$

where L is the length of cable in feet.

The weight per foot of cable is expressed in terms of the tension the cable is expected to bear from the data on the following diagram. The weight per foot in pounds is there plotted as abscissæ to the breaking strain in tons, as ordinates, for crucible cast steel cables with hemp centres of various makes. The line drawn on the diagram expresses the ratio of strength to weight used. It is about a mean line, and is close to the points (marked △) of Roebling & Sons, 7 strand 49 wire cables. The divergence of some of the points from this line is not so important when we remember that only from 1/7 to 1/8 of this breaking strain is taken in practice for safe working loads. This line gives the ratio $\frac{\text{weight per foot in lbs.}}{\text{breaking strain in tons}} = 0.0522$, or introducing a factor of safety "ρ" to pass from breaking to working strain, and substituting for strain the maximum tension in tons T_{mx} that may be thrown on the cable, we have

$$\text{Weight per foot} = 0.0522\ \rho\ T_{mx}. \qquad (2)$$

At this point it will be necessary to consider again in more detail the ratio between the tensions on the taut and slack side of the driving drum, and their relation to the pull transmitted. The equation has been stated $\frac{T_1}{T_2} = e^{f\theta}$ where f is the co-efficient of friction between the surfaces of drum and belt and θ is the angle of contact on the drum. From this follows:

$$T_1 = \frac{e^{f\theta}}{e^{f\theta} - 1} \times P,$$

where P is total pull transmitted, or $T_1 - T_2$, T and P being taken in the same units.

The expression $e^{f\theta}$ may be put in the form $10^{2.7288\, f\, n}$, where n is the number of wraps that the cable makes on the drum. In this form it is easily calculated, being simply the number whose common log. is the exponent of the expression. n on the cable roads is generally made up of a given number of half wraps. For different values of n the ratios above mentioned have the following values. In the calculations f has been taken = 0.20, the co-efficient of friction for steel on cast-iron (Trautwine):

$n =$		$e^{f\theta}$ or $\frac{T_1}{T_2}$	$\frac{e^{f\theta}}{e^{f\theta}-1}$ or $\frac{T_1}{P}$	*Values of φ
Turns of cable	½	1.875	2.24	2.0
	1	3.514	1.40	1.6
	1½	6.586	1.18	1.3
	2	12.364	1.09	1.2
	2½	23.142	1.04	..
				$n = \infty$ 1.+

*To be explained.

In the different cable roads that I have been able to learn of, the value of n has varied from ½ to 2½, so that in this general discussion a variable term will be introduced for the ratio $\frac{T_1}{P}$ or $\frac{e^{f\theta}}{e^{f\theta}-1}$. For brevity, this ratio will be designated as φ, and this variable would have intermittent values, as shown in the above tabulation. It must be remembered, however, that these values of φ are for the greatest possible values of P, or where the cable is on the point of slipping on the drum. In practice, therefore, φ should be taken somewhat greater. About actual values for φ are written in the last column. In the first value for ½ turn, φ has been decreased, because it is thought that this arrangement would rarely be used, except for a grooved wheel, in which case f would be decidedly larger. Also beyond 2 turns φ has not been taken, as increasing the wraps beyond this is shown to give but slight advantage. Taking tension in tons and pull in pounds, which are the units that have been previously used, we may write

$$\frac{2{,}000\ T_1}{P} = \varphi, \text{ or } T_1 = \varphi \frac{P}{2{,}000} \qquad (3)$$

where φ, as shown, depends only on the winding of cable on the driving drum, and the economic regulation of the tension on the slack side.

In the special investigation of efficiency, φ will be taken as having the value of 1.2, or where the angle of contact is equal to 2 turns. This is the value for the St. Louis cable road, the contact there being four half wraps on the driving drum.

Now T_1 is the maximum tension that would be thrown on the cable from the simple operation of driving it so as to transmit a total pull P. But in determining the maximum tension or T_{mx} to which the cable may be subjected, there is another element that must be considered here. It is the extra strain that may be brought on the cable at any point in starting a train. It may be considered as a local strain coming from connecting a stationary with a moving body, and it might approximate the maximum force exerted while starting the train This strain, taken in tons and called z, will be used as a variable in the general discussion. But first some considerations of the values that it may have may be given, assuming that it equals the

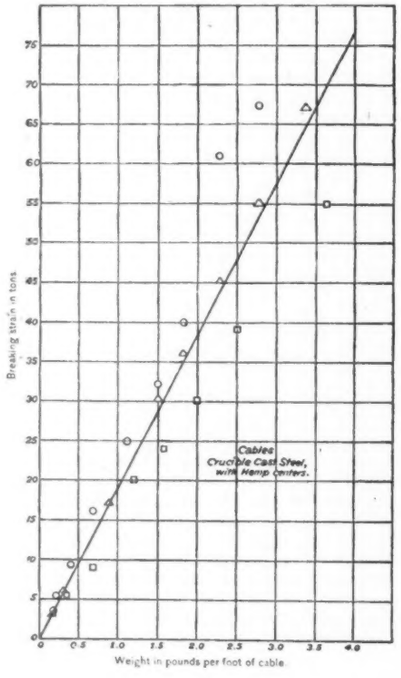


Diagram No. 1.

the maximum force in starting a train. In the paper by Mr. WRIGHT, before referred to, he found, on horse roads, forces as great as 283.5 lbs. per ton in starting cars. This would give for a 12-ton train a value for z of about 1.7. It should be remembered, however, that on horse lines the value found is limited by the pull that the horses can exert, while in cable cable lines it is limited by way the the gripman puts the pressure on the grip. Every one who has stood on a cable car behind a new gripman has felt this force, which at times he could hardly stand against, and if we consider that this force is multiplied by every passenger in the car and also the dead weight of the car and grip, and that the cable may be locally strained by about that amount, some personal idea of the value of z may be realized. In passing, I might state that Mr. WRIGHT's value of 283.5 per ton is about equal to a pull of the kind described of 20 lbs. on the average passenger.

It is probable that on cable roads this force is somewhat greater than the value 283.5 per ton. This as the value for fc before mentioned, or resistance per ton per traction, could so easily be determined together that there is no necessity for any closer assumption of it in this paper. z must enter as a variable in the general equation, since only its value per ton may approach constancy, and there is no objection to regarding its limits of variation extended somewhat so as to include possible future more accurate determinations of its constant element: about the practical limits of z would probably be from 1 to 3, or from an 8-ton train at 250 lbs. strain per ton to a 14-ton train at 430 lbs. per ton. The value of z taken in the special investigation will be 2, or for the 12-ton train already assumed, a local strain of 333 lbs. per ton,

We now have the equation

$$T_{mx} = T_1 + z. \qquad (4)$$

Bringing together now equations (1), (2), (3) and (4), that have been explained in some detail,

$$P_2 = K_2 \text{ (weight per foot) } L \qquad (1)$$

$$\text{(Weight per foot)} = 0.0522\ \rho\ T_{mx} \qquad (2)$$

$$T_1 = \varphi \frac{P}{2{,}000} \qquad (3)$$

$$\text{and } T_{mx} = T_1 + z \qquad (4)$$

And making the apparent substitutions,

$$P_2 = K_2\ L\ 0.0522\ \rho \left(\varphi \frac{P}{2{,}000} + z \right)$$

and remembering that $P = P_1 + P_2 = K_1 L + P_2$.

$$P_2 = K_2\ L\ 0.0522\ \psi \left(\varphi \frac{K_1 L + P_2}{2{,}000} + z \right)$$

Or,

$$P_2 \left(1 - \frac{K_2\ 0.0522\ \rho\ \varphi\ L}{2{,}000} \right) =$$

$$\frac{K_2\ 0.0522\ \rho\ \varphi\ K_1\ L^2}{2{,}000} + K_2\ 0.0522\ \rho\ z\ L$$

Or, taking L in units of 1,000 ft., instead of in units of 1 ft., as in the above expression, and we have finally,

$$P_2 = \frac{26.1\ K_1 K_2\ \rho\ \varphi\ L^2 + 52.2\ K_2\ \rho\ z\ L}{1 - 0.5261\ K_2\ \rho\ \varphi\ L} \qquad (II)$$

A glance at this equation shows the theoretic limit to the length of a given cable road which was mentioned at the beginning of this paper. Where the last term in the denominator equals one, the denominator becomes zero, and hence P_2 infinite, or this may be stated practically as follows: A cable road of that given type of construction could not be run beyond that length without working the cable with a smaller factor of safety than the one chosen. Of course no one would work it close up to this length, since its best possible efficiency would be then next to nothing.

The only quantity in this expression for P_2 that we may not now assign reasonably close values to, in a given case, is K_2, this may be called the co-efficient of cable friction, or the pull in fractions of a pound required to move at the given velocity 1 lb. of cable. Without actual data from roads that have been constructed, very little idea of the value of K_2 could be formed. For my own part, when I first commenced investigating the subject I was decidedly surprised at the magnitude of some of the values found for it, as well as the large variation that it underwent for different roads. In what follows I give all the actual data that I have been able to collect so far on this subject. It is needless to say that this list could have been much enlarged from various sources, if estimates of H. P. had been accepted, but I have preferred to present only those cases where the H. P. was determined by indicator diagrams, and thus an accurate determination of K_2 made.

The data for the following determinations of K_2 on the San Francisco cable roads is taken from a paper by W. W. HANSCOM, M. E., in the *Street Railway Gazette*, 1886, Nos. 6-9.

SAN FRANCISCO CABLE ROADS.

Name of road.	Length of cable in feet	Total weight of cable in lbs.	Speed of cable miles per hour.	Total H. P. to pull cable without cars.	Deduced K_2 or pull in lbs. per lb. of cable.
Clay	11,000	15,400	6	22.6	0.0917
California	25,895	65,000	6	84.0	0.0808
Union	21,000	50,500	6	39.0	0.0799
Market, Valencia & Haight	63,765	164,412	8	201.0	0.0573
McAllister	27,183	68,000	8	60.0	0.0414

Such details of these roads as could be found may be seen by consulting the paper above referred to. They were not sufficiently full to justify an attempt to discuss the specific causes of this variation of

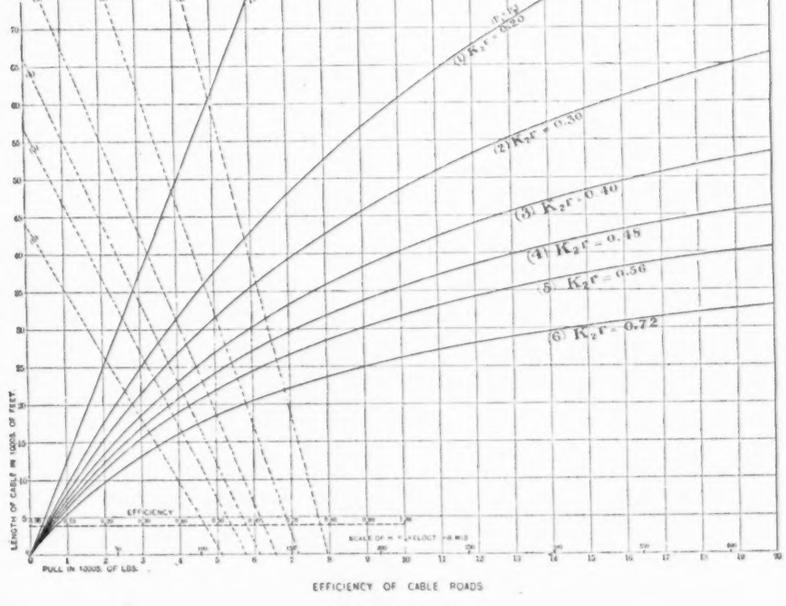
*From Journal of the Association of Engineering Societies.

K_2. It may be stated generally that Clay, California and Union are steep-grade lines, at times about 1 to 6, crossing level streets, involving a number of depression pulleys. Also that Market, Valencia and Haight is described as if it were composed of three separate cables run from one engine.

The following is the data of the St. Louis cable road:

Length of cable in feet.	Total weight of cable in lbs.	Speed, of cable of miles per hour.	Total H. P. to pull cable without cars.	Deduced K_2, or pull in lbs. per lb. of cable.
35,700	89,250	8.	178.5	0.094

The following are the main details of the construction: The line is operated as one cable from power station about ¾ mile from its western terminus; sheaves on line 10 in. diameter, spaced 32 ft. apart; on curves, an 18-in. sheave at each tangent point and filled in between these about as close as can be spaced, 15-in. sheaves on curves of small radius, and on those of larger radius 13-in. sheaves; at ends, elevation sheaves 40 in., turn drums, 9 ft.; diameter of driving drum, 10 ft. The


LENGTH OF CABLE IN 1000s OF FEET
PULL IN 1000s OF LBS.
EFFICIENCY
(1) $K_2\rho$ = 0.20
(2) $K_2\rho$ = 0.30
(3) $K_2\rho$ = 0.40
(4) $K_2\rho$ = 0.48
(5) $K_2\rho$ = 0.56
(6) $K_2\rho$ = 0.72

EFFICIENCY OF CABLE ROADS

Diagram No. 2.

cable makes four half wraps on this drum. The minimum tension on slack side at time of determining the H. P. given above was 1.2 tons.

The road is a double line throughout, making in all 14 turns, or 28 single curves, around which the cable passes, 4 of these 14 turns are through right angles, the others are through various deflections from about 60 deg. down.

For the following data of the Kansas City cable road I am indebted to CLIFT WISE, C. E., Chief Engineer of that road:

The road is a double line throughout, driven at present from one power station near its western terminus. Near its eastern terminus the main cable passes around two pulleys, giving power to these to run a short auxiliary branch.

	Length of cable in feet.	Total weight of cable in lbs.	Speed of cable in miles per hour.	Total H. P. to pull cable without cars.	Deduced K_2, or pull in lbs. per lb. of cable.
Main cable	29,400	88,000	7.1	114	0.068
Auxl. "	5,800				

The main details of construction are: terminal sheaves and drums, 12 ft. diameter; sheaves on curves, 2 ft. 10 in.; carrying sheaves, 2 ft.; on auxiliary cable, carrying sheaves, 1 ft.; 10 sets of depression sheaves on the line, diameter 5 in; 5 right angle curves in the double line.

The variations of all the terms entering the general formula of P_2 have been now considered, and about the limits of the variation and the special causes producing it have been considered in each case, with the exception of the co-efficient of cable friction, or K_2; for this, on roads for which reliable data could be found, the data and the determination of K_2 have been given. We may, therefore, close the general discussion with the equation of efficiency E, as follows, $E = \frac{P_1}{P_1 + P_2}$.

This may be written out from the formula given for P_2 and P_1 but its characteristics will be apparent in the special consideration that follows.

If other engineers are anything like myself, very shadowy ideas are all that are gotten by looking at a general formula, I have, therefore, taken about mean values for all the elements except the three, viz., length of line L, factor of safety in cable ρ, and co-efficient of cable friction K_2, the effect of whose variation, as stated at the beginning, was the special object of this paper. From now on I will in the main consider quantities and not equations.

Taking these mean values, or

$K_1 = 0.0812$, approximate for a 3 minute service on 8 miles velocity of cable with average weight of train 12 tons.

$\varphi = 1.2$, ratio of tension on driving side of drum to pull transmitted about safe for 2 wraps of cable on drum.

$z = 2.0$, local strain in starting a car, or 12 tons by 333 lbs. per ton.

And we have

$$P_1 = 81.2\ L.$$

$$P_2 = \frac{2.5432\ (K_2\rho)\ L^2 + 104.4\ (K_2\rho)\ L.}{1 - 0.03132\ (K_2\rho)\ L.}$$

where L is taken in units of 1,000 ft., and in this equation values will be assumed for $(K_2\rho)$, covering about all the possible range in the product of these two quantities and for each assumed value of $K_2\rho$), the car pull, the cable pull, the total pull, and the efficiency will be determined for the different values of length of road up to 80,000 ft. or up to 20,000 lbs. pull (a little over 400 horse-power on an (8-mile velocity).

A word first in regard to the nature of the product $(K_2\rho)$. It has been already pointed out that there is in part some reciprocal variations between the elements, that while an increase in ρ would increase their product, yet it would not increase as an exact multiple, for its increase would involve a decrease in the tension element of K_2, the friction per unit weight of cable, due to tension, being less the smaller the tension per unit weight, or the greater the factor of safety. It is hardly probable therefore that the extreme values that will be taken for this product in what follows are possible in reality. For instance, on the McAllister road $K_2 = 0.041$, its factor of safety is over 10, though not exactly known from the data; the extreme in this direction will be taken as $(K_2)\ \rho = 0.04 \times 5 = 0.20$, the other extreme will be taken as $0.09 \times 8 = 0.72$.

The values taken for this product are

$(K_2) = 0.20$ (1)
0.30 (2)
0.40 (3)
0.48 (4)
0.56 (5)
0.72 (6)

Probably all actual values would be found between 0.30 and 0.56.

In the place of a tabulation of these values I have substituted a diagram as best illustrating the nature of the variation, and it must be remembered that this is all that is here aimed at, for each road would have special values of K_1, φ and z, probably differing from those here assumed.

On this diagram, length (L) is taken as ordinates, and pull (P) as abscissæ. The car pull is there plotted for different lengths, giving the straight line marked P_1. The total pull, or $P_1 + P_2$ is plotted for the different lengths for the six values assumed for $K_2\rho$, giving the six curves marked (1)—(6) with the value of $K_2\rho$, with which each is calculated. The distance in the direction of pull between the line of car pull and the curve of total pull gives in each case the value of cable pull for that case. For the sake of easy comparison, a scale of H. P. equal to any given pull on a cable moving at a velocity of 8 miles per hour is placed above the scale of pull.

For efficiency, its value, like pull, is taken as abscissæ, to length as ordinates; for clearness the scale and lines of efficiency are drawn as broken lines. This efficiency $\left(\frac{\text{car pull}}{\text{total pull}}\right)$ is determined for each of the six different curves of total pull, and its value in each case for different lengths, plotted; giving the six broken lines marked (1) — (6). These lines correspond to the curves of total pull marked with the same number, and each one gives the variation of efficiency with length in that case, while their different positions show the difference in efficiency and its variation with length resulting from different values of $K_2\rho$. The importance of this element may be now seen; for example, assuming as before the probable actual limits to this product $K_2\rho$ of 0.30 and 0.56, these values, on a road designed for the service here treated of, and cable 35,000 ft. long, would represent efficiencies of respectively 48½ and 22¼ per cent., or more than double the power to operate the one than the other.

Before closing I wish to point out a method for making all the calculations needed in an investigation of any special case, much more simply than the direct one which has been followed in this paper for the sake of its logical order. It is seen that the variation of efficiency with length is in each case on a straight line. This might have been easily deduced from the general equation, which by simple reduction, becomes, in its most general form:

$$E = \frac{1000\ K_1\ (1 - 0.0261\ K_2\ \rho\ \varphi\ L)}{1000\ K_1 + 52.2\ K_2\ \rho\ z} \qquad \text{(III)}$$

K_1 being thus determined by the traffic for which the road is built, φ by the arrangement of cable on driving drum, and z, by the starting strain of a loaded train, we may, from the curvature and general plan of the road, assume moderately narrow limits between which the actual values of $K_2\ \rho$ would be found. Two points in the efficiency line for each of these values would then graphically determine two lines between which the actual efficiency would be found at any length, and the H. P. required to operate any length, would lie between the two values obtained by dividing the H. P. corresponding to car pull there, by the two limits of efficiency at that length.

In default of any personal knowledge by which we may expect to fix reasonably close limits in a given case to this value $K_2\ \rho$ we may probably, with moderate approximation for cables beyond 20,000 ft. in length, and for a fairly heavy traffic carried in trains, determine the efficiency by assuming an initial value of 75 per cent. for fair construction, and from this initial value subtracting 3½ per cent. for every half mile of double track road, and 3½ per cent. for every right angle curve of the double line, or for every two right angle curves of a single line, curves less than a right angle being given a value equal to (3½ versin ∠) where ∠ is the total angle of deflection at any curve.

In the above, the equivalents of a right angle curve to a half-mile of line comes to me second-hand from Mr. ROBT. GILLAM, former Chief Engineer of the Kansas City Cable Road. I do not know on what experimental data it rests; the rest of the statement depends on a mixture of theory easily followed in examining the general equation of efficiency, and on assumption that $K_2 \rho = 0.30$ is about a correct mean value for fair construction and straight road.

I wish it to be recognized that I make this last statement in regard to an approximate determination of efficiency with a *very mild* emphasis. I have found it convenient in my own case, as giving a definiteness to thought on the subject, and a rapid method of at once mentally approximating the effect of different locations of power stations, and I therefore simply give it for what it may prove itself to be worth.

The Straightening of the Pennsylvania R. R. in Jersey City, and Proposed Improvements.

The Pennsylvania Railroad Co. have already made some very radical changes in their approach through the Bergen Hill and are still further straightening their line. As shown on the sketch (Fig. 1) presented herewith, in dotted lines, a comparatively straight line now replaces three very sharp reversing curves. And the 6° and 8° curves still used by the road will very soon be supplanted by the new line indicated. The deep cuts required by these alterations through the hard rock of Bergen Hill have been very expensive, but the saving in maintenance of way and rolling-stock under the enormous traffic will very soon pay royally for the outlay.

The next improvement contemplated, and for which the plans are already contemplated, is the elevation of the roadway from Bergen Hill to the depot in Jersey City. The exorbitant demands for right-of-way and some adverse action of the city authorities have delayed its execution, and may result in an entire change in the line of approach to the river, according to present rumors.

Where streets are to be crossed, the least headway allowed is 13 ft. The general design of the metallic portion of the elevated structure is sufficiently shown in Figs. 2 and 3, which show cross-sectional views of two different designs. Judging from the profile in our possession, the posts will be located about 50 ft. apart longitudinally. The maximum gradient is 0.47 per 100 descending towards the river.

The map Fig. 1 is further interesting as showing the approach of the various trunk line systems to front, some thirteen railway companies being accommodated thereon.

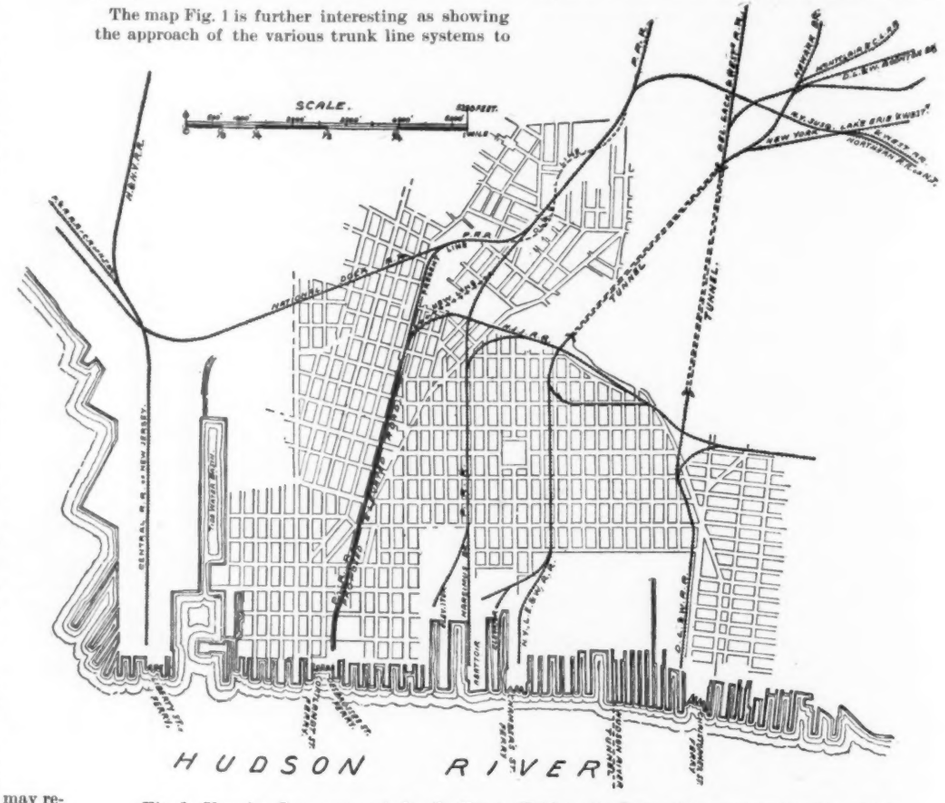


Fig. 1—Showing Improvements by the Penna. R. R. in its Jersey City approach; and also the General Railway Terminals at the same point.

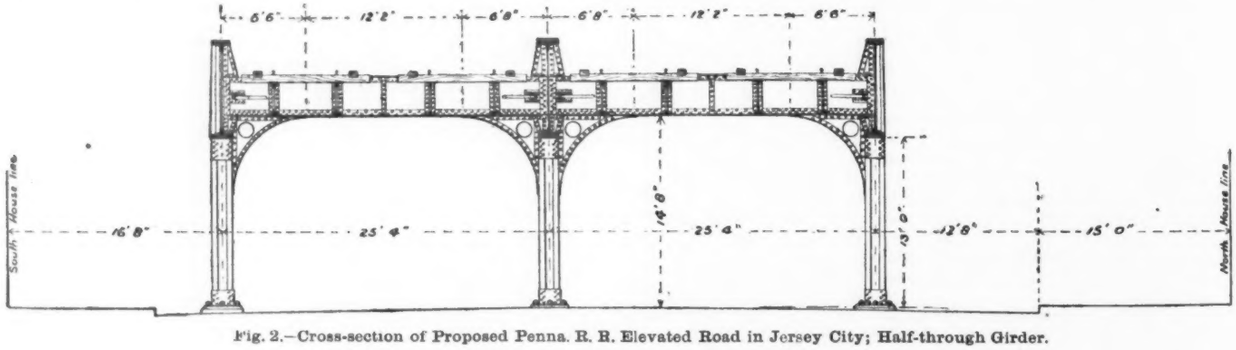


Fig. 2.—Cross-section of Proposed Penna. R. R. Elevated Road in Jersey City; Half-through Girder.

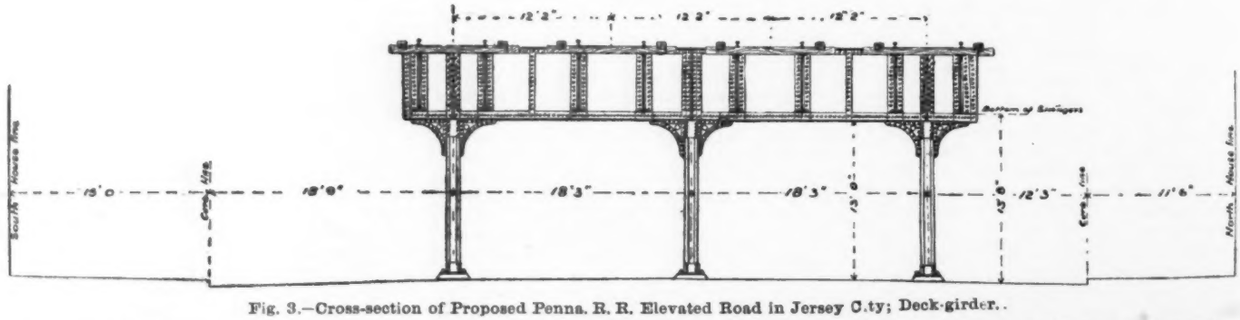


Fig. 3.—Cross-section of Proposed Penna. R. R. Elevated Road in Jersey City; Deck-girder.

As at present designed, this elevated road would commence about at Brunswick street, and its four tracks would be carried partly upon a walled-embankment and partly upon a system of plate-girders, the Hudson river front, the West Shore-Weehawken entrance alone being omitted. The map practically tells its own story and shows what a vast traffic can be concentrated within less than two miles of water-

The Righi Railroad.

Some interesting particulars respecting improvements made on the rack railroad from Vitznau to Righi, in Switzerland, were given in a recent number of *Le Genie Civil*, by M. TH. TSCHIERET, C. E.. The regular operation of the line was commenced in May 1871 with three locomotives, and in 1873 there were ten engines in use. These engines were of the vertical

boiler type, similar to those originally used on the Mount Washington Railroad; they were carried on two axles and had the driving cog wheel keyed on the rear axle. This arrangement has been abandoned on the Mount Washington Railroad since 1876 by the American engineer, who entirely changed the type by adopting a horizontal boiler with rectangular fire-box and horizontal tubes; these latter engines (which are now in use) had also two pairs of cylinders, each pair driving an axle carrying a cog wheel. The engines on the Righi Railroad, being of more careful construction and being kept in good order, lasted longer, but their fuel consumption being very excessive it was finally decided in 1884 to reconstruct them. Up to the date of the article in *Le Genie Civil*, five engines had been altered, and the others are to be altered in due course.

The cylinders, gearing, the distribution of weight, and the frame have been left as originally arranged, but new boilers have been put in, of the ordinary locomotive type with horizontal tubes.

The principal dimensions of these engines, as altered, are as follows:

Heating surface -Firebox	64.56 sq. ft.
" " Total	516.48 sq. ft.
Length of tubes	6.56 ft.
Number "	161
Grate area	10.76 sq. ft.
Diameter of cog wheel	24.8 ins.
Diameter of cylinders	10.5 ins.
Stroke of cylinders	15.6 ins.
Weight—Empty	14 tons.
" In working order	17 tons.

The reconstructed engines, like the old ones, have one cog wheel keyed to the rear axle. When the alterations were made, an experiment was made with the cog wheel on an independent axle placed between the two carrying axles, but the condition of the track and especially the sharp changes in the profile, necessitated the abandonment of this arrangement. The line is only operated for six months in the year, and the engines had, therefore, made seven complete years of service before their reconstruction. The company's returns show that they have run a total of 18,600 miles each. Since the opening of the line the ten engines have made altogether 198,400 train miles.

A striking fact as to the rack has been noticed within the last few years. In the American rack the cross bars are of round iron, but on the Righi line they are of trapezoidal section. This arrangement, added to the general form of the rack, causes a rapid destruction of the rack, which does not seem to be produced on the American rack. The rack, as is generally known, is formed by short iron bars of trapezoidal section, turned at the ends, and riveted into angle irons about 10 ft. long, forming a "ladder," of which the rounds are 3.9 ins. apart. These sections form the rack, being placed end to end and fastened to the wooden cross ties by spikes passing through the horizontal flanges of the angle irons. Repairs are very troublesome, as the breaking of one bar necessitates the replacing of an entire section. The destruction of the bar is described under three stages, as follows: (1). Grease will be noted surrounding the heads of the rivets of a number of the bars; this grease must come from the spur wheel and can only get to the outside of the angle irons by working through along the turned ends, which it can only do if there is a certain amount of play in the hole; (2). This play of the ends once started, increases rapidly, and the bars will soon be loose: this state of affairs is already alarming, as the play will become sufficient to allow the bar to partially rotate, so that the spur wheel, in traversing the rack, will fail to gear correctly; (3) This inaccuracy in the gearing, added to the blows from the teeth of the wheel at each passage of the engine, ends by breaking the angle irons between the bars, which is very liable to cause serious accidents. The company's officials, however, who are very attentive and careful, do not consider the appearance of a crack dangerous, even if several inches long, if in the middle of a section; all broken sections, however, are carefully examined and watched, and are replaced at once if the crack begins to approach either of the ends.

In conclusion, M. TSCHIERET pertinently suggests that the causes of these failures may be looked for in the design of the rack, composed of a number of separate pieces subjected to violent and repeated blows, resulting from the teeth of the spur wheel taking the long step of 3.9 ins., and also in the trapezoidal form of the bars.

The Burlington Tests of Train Resistance of Complete Trains.

[The following very interesting and important extension of the train resistance computations which were made of last year's Burlington brake tests, and comparison of the results of years, appears in the report of the committee in charge of the tests. We have separately discussed it elsewhere. Together the tests constitute by far the best and most trustworthy evidence of the resistance of complete freight trains which exists. ED. ENG. NEWS.]

The following figures give briefly the results of the No. 7, special tests made to determine the frictional resistence of the various trains. The trains were composed of 49 or 50 empty cars with dynamometer and way-car and American type engine and tender. The track and rails were in good condition and the wind light.

Each train was tried once on a slightly descending tangent, and once on a curve, situated on an average descending grade of 50.6 ft. per mile. The resistance was ascertained on the tangent by running up to stop-post No. 1 at about 20 miles per hour, and then shutting off steam and allowing the train to run until it came to a stand-still.

The resistance on the combined grade and curve was ascertained by running the train up to stop-post No. 3, at a low speed, (about 5 miles per hour) and then shutting off steam and allowing the train to run until stop-post No. 4, was reached. The speed at the moments of passing each stop-post were carefully noted.

It will thus be seen that the resisistance given below includes, not only the resistance of the cars, but of the engine running without steam. This is probably greater per ton than that of the cars, but the weight of the engine, about 40 tons) is so insignificant in comparison with that of the cars (700 to 800 tons) that the influence of the engine in running without steam may be neglected, and the resistance given may probably be taken to represent fairly the resistance of new empty cars.

In making this average, the Hanscom results on the curve are excluded, as they are not based on sufficient data to be trustworthy. The "mean speed" is the average of the squares of the speeds. [The Hanscom brake-shoes rubbed against the wheel, and the tests of that train have no meaning. The difference between the resistances of 1886 and 1887 is nearly all explained by the fact that the one trains were loaded and the others empty—ED.]

The cars were new, and were tried empty. The Pennsylvania cars were lubricated with dope. The Eames cars when loaded, after these trials' gave trouble from hot boxes. The great resistance of the Hanscom train was caused by the brake-shoes binding on the wheels. The brake-shoes on the Eames train were also in some cases very close to the wheels and apparently affected the friction of the train on the curve. The brake-shoes on the Westinghouse train were hung inside; all the others were hung outside the wheels.

The trials on the curve were made between stop-posts Nos. 3 and 4. About half the total distance is on a 2 deg. 40 min. curve (2,149 ft. radius) extending over nearly a quarter of a circle (80° 40' 10") and the remainder of the distance is on curves averaging about 1 deg. or say about 6,000 ft. radius.

The results given in similar trials of brake trains over the same ground in 1886 were as follows; the trains were, however, composed of 25 cars, 12 loaded to their full capacity, and 13 empty.

The committee are indebted to Mr. A. M. WELLINGTON for the calculations giving the results of the trials in 1886.

The results for the two years agree fairly well. The average difference between the resistances of the tangent and on the curve was 1.84 lbs. in 1886, and 1.70 lbs. in 1887. One train of cars (Westinghouse, 1886), gave a resistance of only 4.32 lbs. on the tangent, while another train (Hanscom, 1887), had a resistance of 12.00 lbs. per ton on the tangent, or nearly three times that of the C. B. & Q. cars in the lighter running train. This difference was apparently principally due to the brake-shoes rubbing against the wheels, and was equal to a constant grade against the train of 20 ft. per mile. In running from New York to Chicago, 1,000 miles, the extra resistance would be thus an equivalent to surmounting an elevation of 20,000 ft. or more than the height of the highest mountain in North America. The importance of keeping the brake-shoes clear of the wheels is thus very evident.

In the 1886 trials the Chicago, Burlington & Quincy, the Indianapolis, Decatur & Springfield and the Lehigh Valley trains were composed of cars that had been running some time. The St. Louis & San Francisco cars were new. The C. B. & Q. cars (Westinghouse) had the brakes hung from the trucks and inside the wheels. All the other cars had the brake-shoes hung outside from the body.

Train Resistance Tests, (1887).

Patterns of Cars.	Brake.	Tangent. Speed. Average.	Tangent. Speed. Mean.	Tangent. Resistance, per ton of 2,000 lbs.	Curve. Speed. Average.	Curve. Speed. Mean.	Curve. Resistance, per ton of 2,000 lbs.
		Miles.	Miles.	Lbs.	Miles.	Miles.	Lbs.
Pennsylvania	Westinghouse	15	15	5.87	19	23¼	8.72
Illinois Central	Carpenter	14½	15	6.22	15¾	22¼	9.09
C. B. & Q.	Eames.	11½	14¼	7.51	13¾	20	11.0
Average			14¾	6.53		21.7	9.60
St. Jo. & St. L.	Hanscom	11⅛	15	12.00	4	4	19.8 (?)
Average of all tests		13¼	15	7.90			

The following figures, based on the average results obtained in 1886 and 1887, show the increased friction on the curve as compared with the tangent:

	Increase, lbs. per ton.
Shoes hung from the truck and inside the wheels	2.30
Shoes hung from the body and outside the wheels	2.84

These results tend to show that the resistance on curves is increased considerably when the shoes are hung outside the wheels and to the body. When the truck swivels, the shoes, being hung to the body, are lifted and brought closer to the wheels by the greater inclination of the hangers. When the shoes

Train Resistance Tests, (1886).

Pattern of Car.	Brake.	Tangent. Average Speed.	Tangent. Resistance per ton of 2,000 lbs.	Curve. Average Speed.	Curve. Resistance per ton of 2,000 lbs.
		Miles.	lbs.	Miles.	lbs.
C. B. & Q.	Westinghouse.	20½	4.32	26¼	6.07
I. D. & S.	Eames.	16¾	6.84	21⅜	9.42
Lehigh Valley.	Widdifield & Button	16¾	6.84	21⅜	9.42
St. Louis & San Francisco	American.	11⅞	8.50	21⅛	8.94
Average 1886		16¼	6.62	22⅜	8.46
" 1887		13¾	7.90	16¼	9.60
Average of both years		14¾	7.26	19½	9.03

are hung from the trucks, no such action occurs, and the shoes remain the same distance from the wheels, whether the car is running on a tangent or on a curve.

The fact that outside-hung shoes rub more forcibly against the wheels on curves, is not only shown by the figures given above, but was also observed when the trial trains were being hauled over frogs and curves in the yard at West Burlington.

The size of journal bearing has doubtless an important influence on the friction of trains, and the subjoined figures give the sizes of the journals in three of the trains tried at the 1887 tests, together with the weight of each car, empty, and loaded to its full marked capacity, and the resultant load per square inch on the journals. The bearing area of the journals is assumed as the length and diameter multiplied together:

Frictional Resistance, lbs. per ton of 2,000 lbs.

Speeds 12 to 25 miles per hour.

	New cars.	Old cars.
	lbs.	lbs.
On tangent	8.00	6.00
On 3° curve	10.50	8.30

[It is to be always remembered that these figures are for *complete* trains, including engine.—ED.]

Good lubrication and carefully fitted boxes and journals may with cars that have been running some time, decrease this resistance to a minimum of 4 lbs. per ton on the tangent, while brake-shoes rubbing against the wheels, and other unfavorable conditions may increase the friction on the tangent to 12 lbs. per ton, and to considerably more on curves.

Cars.	Journal length and Diameter.	Weight of car.		Pressure per sq. in. on journal.		Friction tangent.
		Empty.	Loaded.	Empty.	Loaded.	
	Inches.	lbs.	lbs.	lbs.	lbs.	lbs.
Pennsylvania	8 x 4	30,577	90,577	119	354	5.87
Illinois Central	7 x 4	27,351	67,351	122	301	6.22
C. B. & Q.	7 x 3¾	25,509	65,509	121	312	7.51

As the frictional resistance given was obtained with empty cars, where the load per square inch on the journal is practically identical, the variation found in the resistance is due to other causes than insufficient bearing surface. The highest amount of friction was shown in 1887 by the C. B. & Q. cars, which in 1886 showed the least. In both years the cars were of the same design, but in 1887 the cars were new, whereas in 1886 they had run over 10,000 miles. The difference was therefore probably due to less accurate fitting and workmanship as compared with the Pennsylvania and Illinois Central cars, which were also new, but showed respectively 1.64 and 1.29 lbs. per ton less friction than the C. B. & Q. cars. These differences, insignificant as they may appear, would, in running 1000 miles, necessitate an extra amount of haulage power equivalent to surmounting summits 4,330 and 3,415 ft high respectively, or greater than that of any line between the Mississippi and the Atlantic. The importance of good fitting is further shown by the C. B. & Q. cars running hot, when loaded, after the resistance tests.

The Pennsylvania and Illinois Central cars were built at the company's shops, and the C. B. & Q. cars were built by a contractor.

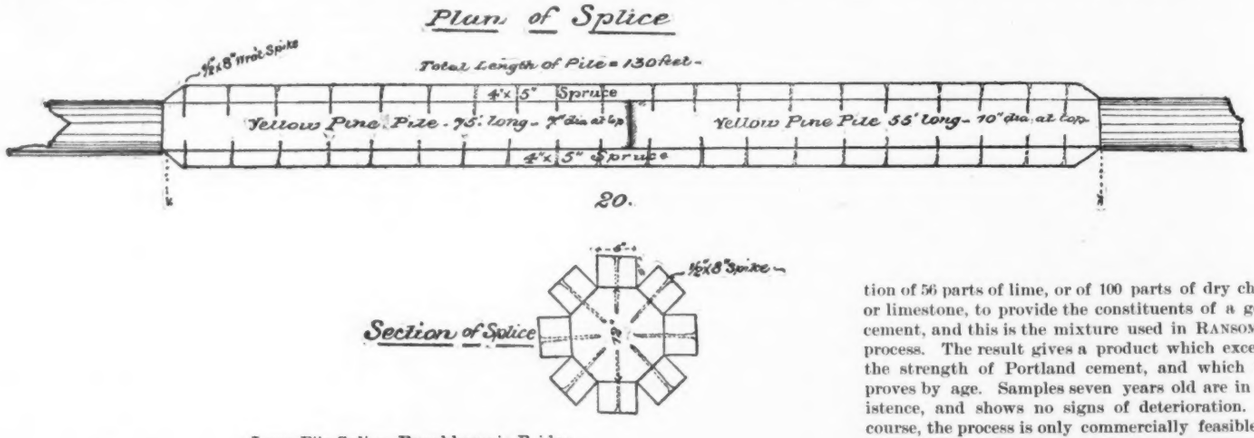
Your Committee believe from these experiments that the following figures represent the frictional resistance of long trains of freight cars in good repair running over a track in good condition, the weather being fine and warm, and the wind light. The resistance appears to be constant at speeds of from 12 to 25 miles per hour, and does not appreciably increase with an increase of speed within these limits.

The use of outside hung shoes seem to increase the resistance on curves when the shoes are very near the wheels.

Long-Pile Splice; Poughkeepsie Bridge.

We are indebted to Mr. JOHN H. STAATS, Engineer for Messrs. Ross & Sanford, for the accompanying sketch of a long-pile splice used by these general contractors at the Poughkeepsie Bridge now under construction. The great depth of water, about 55 ft., and the deep mud stratum forming the bed of the Hudson river at this point made piles of an unusual length necessary in supporting certain parts of the false works and in use in connection with the more secure anchorage of the cribs during the sinking process.

The sketch gives such full detail that further description is unnecessary, and we can only say that the splice proved to be a very good one and resulted in a stiff pile that most successfully fulfilled all its requirements of loading.


Plan of Splice
Total Length of Pile = 130 feet
4"x 5" Spruce
Yellow Pine Pile - 75' long - 7" dia at top
Yellow Pine Pile 55' long - 10" dia at top
4"x 5" Spruce
20.

Long-Pile Splice; Poughkeepsie Bridge.

Cement From Blast Furnace Slag.

Three kinds of cement are made from blast furnace slag. The first, which is really more of a mortar than a cement, is produced by taking slag sand and grinding it with 15 per cent. of lime and 15 per cent. of oxide of iron. The grinding is generally done wet, and the product requires to be used within a few hours of being made, so that its employment is quite local. The second cement is made by grinding 75 per cent. of dry slag sand with 25 per cent. of dry slaked lime, according to Mr. LARSEN'S patent. It is essential that the ingredients should be reduced to a fine degree of pulverization, and that they should be intimately commingled; for this purpose the inventor uses a machine which he calls a "homogeneiser." The third cement is made according to a process brought out by Mr. FREDERICK RANSOME. Equal weights of slag sand and chalk are ground together in a wet state, and after being dried, are burned either in a kiln or revolving furnace, the process followed being similar to that used in making Portland cement. The following table gives analyses of two of the cements we have mentioned, and also of two examples of Portland cement.

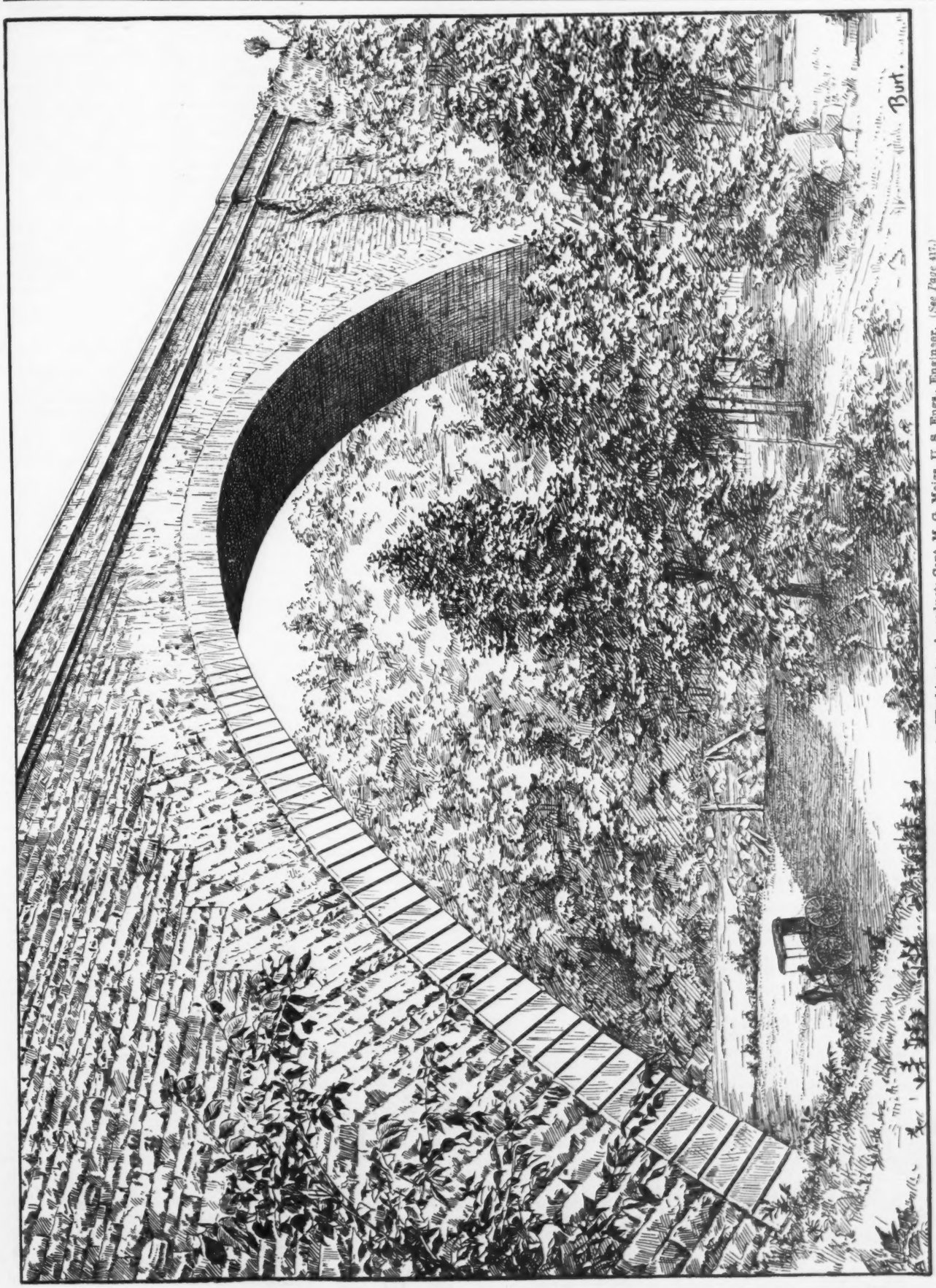
Analyses of Cements.

	Lime.	Silica.	Alumina.	Ferric Oxide.	Ferrous Oxide.	Magnesia.	Water.
No. 1 cement	22.9	21.61	19.85	8.80	4	4.36	12
No. 2 (Larsen)	41.96	24.34	18.74	.14	.27	6.57	4.70
Portland (No. 1)	59.9	24.07	6.92				
" (No. 2)	55.57	22.92	8.0				
Middlesbro' slag	40	52.34					
Middlesbro' slag (No. 2)	36.88	51.12					
Middlesbro' slag (No. 3)	40.45	50.08					

The first and second analyses are by Mr. J. E. STEAD. The non-essential ingredients are not given.

From this it will be seen that the first two cements are widely different in their chemical constitution from Portland cement, and they are still more different in their physical condition, for the lime is mostly free, the materials not having undergone the incipient fusion which Portland cement experiences. Now in the slag, the proportion of lime to alumina and silica is about as 39 : 51, while in cement it is as 58 : 31. Therefore, 100 parts of slag, including the inert matters, requires the addition of 56 parts of lime, or of 100 parts of dry chalk or limestone, to provide the constituents of a good cement, and this is the mixture used in RANSOME'S process. The result gives a product which exceeds the strength of Portland cement, and which improves by age. Samples seven years old are in existence, and shows no signs of deterioration. Of course, the process is only commercially feasible in districts where slag is produced, but there it offers a means of turning a useless product into a valuable material, and if it be carried out by RANSOME'S revolving furnace, the expense for plant is comparatively small.—*Engineering.*

THE late grant by Mexico of 30,000,000 acres of land to HENRY P. CLIFFORD, of New York, and J. A. VERGES, of San Francisco, is one of the largest ever made even in that region of great individual domains. It is a vast parallelogram 358 miles long by 106 miles wide and runs along the Sierra Madre from the United States boundary to the middle of the State of Durango. A portion of it is good land only awaiting irrigation to be made very fertile, and untold mineral treasures are said to simply await developement. The full text of the concession is not yet accessible, but one of the first considerations is a complete survey of this region by the Americans and the opening of its known mines within two years. A surveying force of 300 men, is reported, will at once be put to work and $500,000 spent for this purpose. Smelters are also to be erected, farms and ranches opened and emigration invited with a view to the thorough developement of the territory.



The Cabin John Arch, 220 Ft. Span; Carrying the Washington Aqueduct: Capt. M. C. Meigs, U. S. Engs., Engineer. (See Page 417.)

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D. McN. STAUFFER, A. M. WELLINGTON, EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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THE Master Car Builders' Convention of 1887 will long be memorable, or ought to be, for its action on the automatic coupler and freight brake question which we briefly noted last week, for the importance of the consequences which are likely to flow from it could hardly be exaggerated. The limitations of time and space forbid that we should give that attention to the matter this week which its importance demands, nor is it in one sense necessary, for the brief statement that the Janney hook coupler, or others of the same type coupling with it, has been recommended as the universal standard, and that the freight brake question has got so far that the committee decisively recommend air and evidently lean toward recommending electric application likewise, assuming the practical details of its use can be perfected, gives the gist of the whole matter. The several committees summarize the reasons for these conclusions with admirable clearness and force, and at great length, but to those who have been following the drift of events for the past year or two it was almost a foregone conclusion that this would be the result, and the only doubt, when it would come about; and it is more than probable that such hesitation as there has been among those who had the responsibility of acting was less because of any real doubt, than because the momentous consequences of any decisive action demanded the utmost caution, and careful fortifying of conclusions.

The coupler question is now in the best of shapes. There are half a dozen different couplers of approved merit which will either already couple with the Janney or can readily be made to do so, and while it is expected that a number of these couplers will pool their interests, yet it is not likely that any absolute monopoly which can be felt to be oppressive will result.

We assume that the action at the Convention will be confirmed by letter ballot, for there seems no reasonable doubt that it will be, and very possibly by a much more decisive majority than 33 to 14. The whole railroad world is weary of the contest and anxious to do something, when it is clear what should be done. It has now become clear enough for any reasonable man, and that it will be generally so regarded we cannot doubt.

The brake question has not yet reached the point of final recommendation, and perhaps it never will, but the drift of events will be allowed to settle it. The range of choice is narrow and that always helps toward an early decision. Had there been only two or three or four or five couplers which could be regarded as competitors, a decision would probably have been reached long ago. We question greatly if the recent tests have not for the moment rather retarded than hastened the introduction of freight brakes, by the brilliant yet dubious part which electricity played in them. The tendency to await definite evidence as to just what should be done with electricity will be strong and reasonable. But once begun, the introduction of freight brakes will go on very rapidly, and five or six years will probably see a great change in our freight equipment, in more ways than one.

Among the other communications which we have received in relation to the Brooklyn bridge question, there has been one giving elaborate plans for a "circulating system" indeed, consisting practically of a continuous train of cars which never stop, but pass around a moving turn-table at each end, having of course a very small velocity at the center, and a velocity as great as the train at the periphery. Passengers are supposed to enter from landings at the center of the turn-table, and in walking out to the train gradually acquire the necessary velocity to enter the train as if at rest.

Our correspondent seems not to be aware that this is a very old idea, which has been proposed again and again for such conditions, and never found practicable. His only new feature is that, in order to diminish the necessary size of this turn-table, he makes it of concentric rings, each traveling slightly faster than the other. Passing the question of the necessary rigging, and the number of parts to break, an insuperable objection if there were no other is that "old women of both sexes," as well as children and invalids, cannot use such an apparatus with comfort or safety, and such must be provided for. In the cellar of a building within two minutes walk of the Brooklyn bridge terminus is a very elaborate model of an apparatus of this kind, which was very earnestly advocated for the elevated lines when the rapid transit question was a live one in this city, and secured many friends and advocates, but not many among engineers.

It is announced that the terminal committee are now engaged in preparing their report, which may be delayed for some weeks or even months. Pending the appearance of that report, which we risk little in saying will be a more carefully prepared and defensible document than was the last, discussion of all other possibilities and suggestions seems inexpedient.

IN answer to the inquiry of a correspondent, we may state that in the statistics of the growth of traffic over the Brooklyn bridge which we gave in our issue of June 4 the traffic of 1883, during which the bridge was actually in operation only a few months, was pro-rated on the assumption that the traffic of those months would bear the same ratio to what would have been the full traffic of the year, had the cable cars been in operation, as the traffic for the same months of the next year bore to the whole actual traffic of that year. This gave us the following figures, in which the apparent increase from 1883 to 1884 is much less than the actual simply because the figures for 1883 were thus enlarged pro-rata;

Thousands	1883	1884	1885	1886
Total pass'rs.....	5,440	8,491	17,023	24,029
Increase per year.....		3,051	8,532	7,006

This is plainly a fairer way of indicating the true law of growth than to give the actual figures for the end of 1883 only, which would have been but little over 1,000,000.

It is clear by analogy from the figures for the internal traffic of New York, Brooklyn, London and other cities, which we expect shortly to present, and which we think can not but be of great interest to those having to do with all forms of city and suburban traffic, that even the enormous growth so far leaves the traffic yet a small one compared with what may be expected in the near future, if proper facilities for handling it exist.

THE approaching Annual Convention of the American Society of Civil Engineers, promises to be very largely attended, particularly in the number of ladies. The place for holding it is a very delightful one, and we suspect will do much to reinforce the conclusion to which many came after the Deer Park Convention of 1885), that the true place for such conventions is at some large summer hotel in retired localities, where no entertaining arrangements beyond opportunity for quiet rest and conversation are necessary, and where there are not too many things to do and see. An additional paper is announced on "Inspectors and Bridge Work," by SAMUEL TOBIAS WAGNER, C. E., a subject which might well bring out a lively discussion.

As a reply to our note last week in respect to 185 trains arriving and 189 trains departing daily from the Broad St. station, Philadelphia, a correspondent sends us the printed time table for their departure and arrival, showing precisely those numbers. There must be, of course, in the long run, as many locomotives and cars run in as run out, but the cars for the four extra trains out may be obtained from the others, and the extra engines used in freight service or run back light, which is probably the case. The distribution of these trains through the day is curiously even, as the following tabulation will show. There are only two hours of the day when there are no trains, and six hours (midnight to 6 A. M.) when there are less than 5 per hour:

Trains in and out of Broad St. Station, Philadelphia.

	Arrive.	Depart.
Midnight to 1 A. M.	3	3
1 to 2 "	0	0
2 " 3 "	0	0
3 " 4 "	3	2
4 " 5 "	1	3
5 " 6 "	2	1
6 " 7 "	7	10
7 " 8 "	14	15
8 " 9 "	21	8
9 " 10 "	14	7
10 " 11 "	11	7
11 " 12 M.	10	9
12 " 1 P. M.	8	8
1 " 2 "	7	6
2 " 3 "	7	12
3 " 4 "	9	11
4 " 5 "	7	15
5 " 6 "	10	21
6 " 7 "	13	18
7 " 8 "	14	5
8 " 9 "	7	6
9 " 10 "	5	5
10 " 11 "	9	8
11 " Midnight.	3	9
Total.....	185	189

LAST week the iron railway bridge over the Conemaugh river near Johnstown, Pa., was moved laterally about 75 ft. to accommodate trains while a new stone arch bridge is being built. The iron bridge was double-track and 250 ft. long. Trestles were set up, rails laid on these, trucks put under the bridge, and in about 8 hours the bridge was on its new supports 75 ft. down stream, and the tracks shifted to suit. A handsome and very substantial stone bridge is to replace it.

OFFICIALS of the Pennsylvania Railroad Company state that their experiments in heating cars by steam have been entirely successful, so that the days of heating by separate fires on that road are numbered.

An Instructive Accident.

The crash at Havre de Grace on the Pennsylvania (P. W. & B.) last Monday, which we have briefly noted on our news page, was in several ways of a rather notable character. The primary cause which made the accident possible was an unusual one, viz. the interlacing of double tracks so as to enable them to pass over a single track bridge, which we find it stated in the newspapers is called a "gauntlet" by railroad men. We never heard the name before, but it is a name for something which needs a name, and certainly an apt and appropriate one, and as such we will use it. There are a great many of these "gauntlets" in various parts of the country—probably one or more on every long double track road—but double track roads are few, and the "gauntlets" on them are also few, and very carefully watched and guarded, so that the accidents from them cut a small figure in the aggregate. When they do happen they are very apt to be serious ones, that at Havre de Grace having been one of the least so which could be reasonably expected, largely because the train had very few passengers.

These "gauntlets," we need hardly say, are effected by putting in a frog at each end of the bridge, as if for a switch, and then running the tracks almost together, but carrying the rails along side by side instead of running them together by a switch. Saving the additional danger and inconvenience of the latter is the only gain. For operating purposes the track is a single track, and must be regarded and protected as such. It is precisely the arrangement which it was recently proposed to introduce over the Brooklyn bridge, as discussed in our issues of June 4 and 11, and precisely the kind of collision happened which we then suggested would be liable to result on the bridge, an oblique head collision, or one train crashing into the side of another moving in the opposite direction. It is a rather curious coincidence that so apt an illustration of the danger should have occurred so soon after we had occasion to discuss it.

Quite apart from the Brooklyn bridge question, however, which in respect to this particular danger has now become ancient history, the accident carries a very clear and important moral. The Pennsylvania Railroad is very thoroughly equipped with the best of safety appliances, and very carefully managed. It was the first road in the country to adopt the block system and that system was in full operation at the point where this accident occured. Nevertheless it did occur, in broad daylight and in clear weather, and in so doing emphasized the conclusion to which we came in our former discussion: All such points are in effect GRADE CROSSINGS, and must be protected and treated as such to secure even reasonable safety.

The circumstances of the accident were these: The north-bound "Congressional express" had been duly blocked some distance back by a broken down freight train which it finally ran around, losing 17 minutes of time. It reached Havre de Grace station, just south of the bridge and "gauntlet," and was again duly blocked, but either because the air brakes were out of order or (as seems far more likely from the accounts and probabilities) the engineman was forgetful and ran by his signals, so that he did not stop quick enough, the express crashed into the side of a down train just pulling out from the station and partly on the "gauntlet." The block at the north end of the bridge had duly permitted it to pass, it having the right to the road.

The south-bound train consisted exclusively of Pullman cars, three of which were toppled over by the force of the collision, leaving their trucks on the track. Their wreck was very complete, but as there were less than a dozen people in each car there were only some 17 injuries which could be called such, and one death.

Now in respect to the ordinary grade crossing practice is well settled, and no practical railroad men think of questioning it any longer. It is easy enough to reason out that various other ways are safe enough for protecting them, but hard experience has shown that there are but two ways that will answer:

First (a very partial protection) by a dead stop of every train just before reaching the crossing, *in addition to* signals controlled by a watchman and the natural eye-sight and hearing of an engineer, which latter alone will ordinarily give warning of any dangerously near approaching train. These two latter protections alone were assumed to be sufficient in the early days of railroading, but they proved utterly unreliable. Even with the dead stop added, two per cent. of all the train accidents in the United States happen from crossing collisions, and a much larger proportion of the casualties therefrom.

Secondly, (the only perfect protection) by interlocking apparatus, which is absolute in its working. This must consist of (1) a distant signal, (2) a home signal, and (3) most important of all, a derailing switch just beyond the home signal, to run a train which neglects the signals off the track and into as smooth a ditch as possible, so as to do little damage. With these three protections on each road on each side of the crossing, and interlocked so that safety cannot be shown in one direction without having danger on all the others, the crossing is absolutely safe, except in one respect; that a careless signalman, after having let one train pass the signals, may change them so as to let another train run into it before it has cleared the danger point. This apparently remote danger has proved a real one in so many cases that no crossing is now considered entirely safe without electric locking, which forbids any change in the signals whatever, after one train has entered the block, until it has left them. With this protection added, the crossing is as safe as any other part of the track, without any stop or checking up.

As illustrating the necessity of the derailing switch; the first interlocking apparatus at a crossing in the United States, or nearly the first, was erected at Wellington, O., many years ago. The track is straight for a long distance and the country flat. The enginemen were carefully instructed as to this new device, which as new would be likely to fix itself in their memory. Yet on the second or third trip thereafter, one of the express enginemen ran past the two danger signals and off the derailing switch with another train approaching the crossing.

Such a "gauntlet" as that above described is less dangerous than a crossing in that the trains which may collide are all under the same management, but otherwise there is precisely the same danger both in nature and degree; yet what does even block signal protection of such a point amount to? Simply to what would exist at a crossing if there were a signal-man alone there, to let one train or another pass, without even the protection of a full stop. This indicates what the late accident almost proves, that there cannot be real protection of such a "gauntlet" without treating it as a crossing and protecting it as carefully.

Another curious feature of this disaster was the very trifling shock which resulted from the collision in the north-bound train. A passenger on the train states:

"I was sitting in the second car of the north-bound train on my way from Washington to New York. There was but a slight shock, which I thought was due to a new or careless engineer stopping suddenly. I was reading a paper at the time. No one in my car was injured or much shaken up, but the passengers in the first car ahead were very much tossed about, and those in the smoking car were thrown down, and the tableware and china scattered in all directions. As far as I could learn no one in our train was seriously hurt."

The shocks in the rear of long trains which are suddenly stopped by air brakes, applied with full force, are vastly more severe than this, the reason being that there is no gradual crushing and yielding to break the force of the shock. Strange as it may appear, it was the universal testimony of those who went through the late brake tests and have been through collisions that the shocks from the former were much the worse.

It would also appear certain that the brakes must have been in inferior condition, even if not entirely out of order, for it is stated that it would have been easily possible to stop the train had the brakes worked properly. In one account it is stated that "two seconds more and the crash would have been averted." While this precise statement may be reportorial imagination yet there are a large class of accidents in which two or three or four seconds are a matter of very serious moment, and it indicates that electric application of brakes, as a supplement, or rather preface, to their application by air may yet prove a desirable adjunct for passenger as well as freight trains, both as giving quicker application and as ensuring some application. Simplicity is desirable, but had simplicity been allowed to be a governing consideration we should not yet have got beyond hand brakes. The Burlington brake tests have shown what can be done with electricity, and while they cannot by any means be said to have shown exactly how to do it, yet we cannot but believe that electrical application, with the air to act later if electricity fails, will be almost an essential for handling long freight trains effectively, and if so, highly desirable for passenger trains as well. To stop a train moving at 60 miles per hour, even with the high brake efficiency of 10 per cent. of the weight, takes 1,278 ft., and the loss of 3 seconds more means 270 ft. more. That is a serious matter, with another train approaching.

CORRESPONDENCE.

Connecting Lightning Rods with Water Mains.

MINNEAPOLIS, KAN., June 11, 1887.

EDITOR ENGINEERING NEWS:

I notice in your paper of June 11, an inquiry whether connecting lightning rods to water mains would be liable to damage the mains? Last year a new lightning rod was put on the chimney of the Lowell water-works pumping station, and taking advice from the local electricians, I connected the rod by soldering it into a ⅝-inch corporation cock tapped into a 6-inch water main about 20 ft. from the foot of the chimney. Since then several rods on the city buildings have been connected in a similar manner, and it seems to me to be the best ground connection that can be made, although I would not on any condition have it connected near a cement lined wrought-iron pipe.

Yours truly,

H. G. HOLDEN,
Ex-Supt. Lowell Water-Works, Mass.

[We have recently heard of an instance in which a good sized lead pipe was riddled as by shot by lightning, without a direct connection.—ED. ENG. NEWS.]

An Unsafe Floor Beam.

NEW HAVEN, Conn. June 13, 1887.

EDITOR ENGINEERING NEWS:

As an illustration of structures that violate some of "the most important and fundamental requirements of good bridge designing"—discussions in regard to which have been so frequent lately—I send to you herewith a sketch representing a defective design for a floor-beam of a double-track wrought-iron railway bridge that has happened to come under my observation.

The bridge in which the defective beams occur was built some two or three years ago to replace a cast-iron structure that had been found to be critically deficient in design, and consists of a pivot span of eleven panels, two fixed spans of ten panels each and three fixed spans of nine panels each. It is upon one of the wealthiest and most prosperous trunk lines in New England, and its existence in its present condition is chargeable to the obstinacy of the managers of the railway, who cannot find out after months of searching that the structure in question is in any degree insufficient. Yet, according to the subjoined calculations, which are of the simplest sort of character—the floor-beams of this bridge are so structurally weak in some important details that it is doubtful whether the structure has a safe capacity of more than one-third of that which it was designed to have. All the data and deductions in the premises were long ago laid before the managers of the railway upon which the bridge is located, without any apparent practical result—the only practical result would be the immediate putting of this structure into a condition of security beyond peradventure, a thing demanded by considerations of public safety.

It may be that some of the "hard-headedness" of the parties referred to is due in some measure to the fact that another bridge, involving the same defects as those pointed out below, was constructed upon this railway after attention had been called to these defects. It is humiliating sometimes to have to abandon a position even when it is shown that the position is wrong.

In the interest of good bridge engineering, which is a public interest, for the public suffers most by the lack of it, I hope you will find space for this in your columns, and invite the designer of the structure, as well as the official of the railway also who accepted the structure for his company, to explain their method of figuring and dimensioning the structure in question.

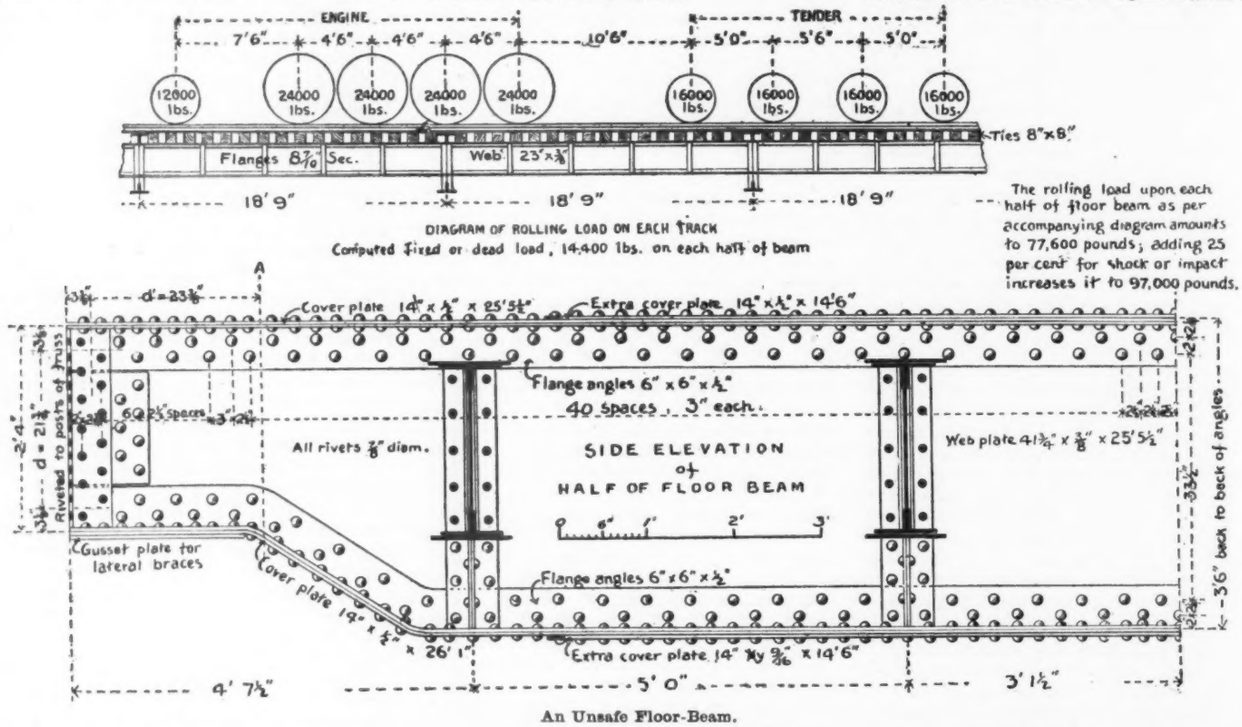
Sincerely yours,

J. E. BUDDINGTON,

STRESSES IN AND CAPACITY OF THE DOUBLE-TRACK RAILWAY FLOOR-BEAM SHOWN IN ACCOMPANYING ILLUSTRATION.

Loads.—The dead or fixed load supported by each half of one of the transverse girders or floor beams indicated in the accompanying sketch, that is, the weight of one panel length of track, rails, ties, guard timbers, stringers, braces, etc., added to the weight of one-half of the floor-beam itself, is found by computation to be about 14,400 lbs. The rolling load brought upon one-half of one of the beams by an engine of the type represented in the diagram is about 77,600 lbs. This is the actual load, without allowance for shock or impact. Adding 25 per cent. for impact would make the live load to be provided for 97,000 lbs. The total load upon one-half the beam, is therefore 97,000 + 14,400 = 111,400 lbs.

Stresses Produced in the Beam by the Above Load.—In making the following calculations, the floor-beam has been regarded as supported by the two vertical lines of rivets in the angle brackets at the end; and the center line of this support would be the vertical line midway between the aforesaid rivet lines, and is 3¾ ins. distant from the end of the girder.


ENGINE
TENDER
7'6" 4'6" 4'6" 4'6" 10'6" 5'0" 5'6" 5'0"
12000 lbs.
24000 lbs.
24000 lbs.
24000 lbs.
24000 lbs.
16000 lbs.
16000 lbs.
16000 lbs.
16000 lbs.
Ties 8"x8"
Flanges 8 7/10 Sec.
Web 23"x 3/8
18'9" 18'9" 18'9"
The rolling load upon each half of floor beam as per accompanying diagram amounts to 77,600 pounds; adding 25 per cent for shock or impact increases it to 97,000 pounds.
DIAGRAM OF ROLLING LOAD ON EACH TRACK
Computed fixed or dead load, 14,400 lbs. on each half of beam
A
d'=23⅜"
Cover plate 14" x ½" x 25'5½"
Extra cover plate 14" x ½" x 14'6"
Flange angles 6" x 6" x ½"
40 spaces, 3" each.
All rivets ⅞" diam.
SIDE ELEVATION of HALF OF FLOOR BEAM
Web plate 41 3/16" x ⅜" x 25'5½"
Riveted to posts of truss
d = 21¾"
Gusset plate for lateral braces
Cover plate 14" x ½" x 26'1"
Extra cover plate 14" x 9/16" x 14'6"
36" back to back of angles
4' 7½" 5'0" 3'1½"

An Unsafe Floor-Beam.

The flange stress at the center of the beam is 1.95 times the total load on half the beam, 111,400 × 1.95 = 217,230 lbs. Adding one-sixth of the section of the web plate of the girder to the flange section proper, which is perhaps allowable because the web plate is here subjected to no shearing stress by the maximum loading, the resulting efficient section of the top flange is 28 sq. ins., and the bottom flange 26.3 sq. ins., net. The stress per square inch of section in the top and bottom flanges of the beam at the center are therefore respectively 7,400 and 8,260 lbs. At the end of the extra cover plate, the flange stress is 1.38 times the total load, or 153,730 lbs.; the top and bottom flange sections, made up as before, are 21.1 sq. ins. and 19.3 sq. ins., and the corresponding stress are 7,290 lbs. and 7,970 lbs. respectively. All the above stresses come well within the usual requirements of good construction, and so far as the flanges are concerned, the beam is amply adequate for the load stated.

The shearing stress in the web plate in the end bar of the beam is obviously equivalent to the total load upon one-half the beam, or 111,400 lbs. The gross section of the web plate is, at the critical point, 10.5 sq. ins.; the shearing stress per square inch is therefore 111,400 ÷ 10.5 = 10,600 lbs. The unsupported depth of the web plate is about 43 times the thickness of the plate, and for this unsupported depth the safe capacity of resistance of the web would be 8,000 ÷ [1 + 1.23] = 3,600 lbs. The web-plate is therefore subjected to a stress about three times the usually assumed maximum permissible limit for safety.

Rivet Stresses in the End Bay of the Girder.—The flange stress at any point of the horizontal flanges of the beam is obviously the stress that is transmitted by those rivets connecting the vertical legs of the flange angles with the web from the point taken, to the end of the beam; for the only way in which the stress can get into the flanges is through the rivets in question. Hence at any point, as A in the diagram, the following relation must subsist: $R\,d' = F\,d$. R being the reaction at the end, d' its lever arm, F the total stress upon all the rivets included between the point A and the end of girder, and d the lever arm of this total stress. From the sketch, R = 111,400 lbs., d' = 23⅜ in. and d = 21¾ in. Hence the total stress transmitted by the whole number of the rivets from the point A to the end = 111,400 × 23⅜ ÷ 21¾ = 119,755 lbs. There are ten of these rivets, so the stress per rivet must be 11,975 lbs. The rivets are ⅞ in. in diameter and bear upon a plate ⅜ in. in thickness; the bearing area per rivet is consequently 21-64 in., and the bearing pressure per square inch of sectional area is therefore 11,975 lbs. ÷ 21-64 = 36,500 lbs! More than three times the maximum limit for safety. [12,000 lbs.]!

The critical weakness and insufficiency of this floor beam may also be clearly shown in the following manner:

The total safe stress for the ten rivets from A to the end of the beam is 10 × 12 000 × 21-64 = 39,375 lbs. Substituting this value of F in the equation given above and the values of d and d' as before given, we obtain as the safe load, R, upon half the beam, 39,375 × 21¾ ÷ 23⅜ = 36,630 lbs. Deducting the dead load, 14,400 lbs., *leaves 22,230 lbs. as the net safe capacity upon each half of the beam. As the actual load thereon is, as already shown, 77,600 lbs., the critical insufficiency or woeful weakness of this structure is glaringly apparent.*

J. E. BUDDINGTON.

[If the details of our correspondent's computations are correct, and they appear to be, the name of the road and the builder would come in appropriately in this connection.—ED. ENG. NEWS.]

Riveted vs. Pin-Connected Bridges.

ALBANY, N. Y., June 13, 1887.

EDITOR ENGINEERING NEWS:

In ENGINEERING NEWS of June 11 I am pleased to see an old friend of mine in the illustration of the broken bridge on the Baltimore & Ohio Railroad, but the date given to you of April 30 is erroneous. It happened on September 16 last, and was caused by a horse which attempted to cross the bridge but got caught between the ties and held until the train struck him.

I do not know whether you speak advisedly in saying that it was computed carefully for the moments of the wheel loads and that the cow moment was omitted, but considering the reputation of the builders (Clarke Bridge Co. of Balti-

more) as well as the fact that the bridge was inspected and approved when building and for several successive years afterwards by Prof. S. W. ROBINSON, M. Am. Soc. C. E., I should infer that it was fully up to modern standards. No doubt the builders or the railroad company would be willing to furnish a copy of the strain sheet, if requested to do so.

In characterizing a pin-connected span of this length as an "atrocity," permit me to say that you are attacking the practice of fully nineteen-twentieths of all the bridge builders and railroads in the United States. But you are right, nevertheless. The span of this bridge was 90 ft. A great majority of bridge specifications make it mandatory with the builder to provide pin-connected trusses for this span, while most of the remainder are optional as between pin-connected and riveted. Thus, the old "Erie" specifications, which have probably been more widely adopted than any others ever published, require pin connected trusses for every thing over 80 ft. The present "Erie" specifications, however, are optional, allowing either pin-connected or riveted construction. The Delaware, Lackawanna & Western requires pin-connected trusses for everything over 80 ft. The New York & New England is the same. In THEODORE COOPER'S specifications the dividing line between pin-connected and "riveted" is at 90 ft. So you see the B. & O. is in good company and if their little bridge was an "atrocity" there are hundreds, probably thousands more, equally atrocious in existence.

But if "pin-connected" construction is inadmissible for 90-ft. spans, will you please advise me for what spans, in your opinion, it should be used? If riveted construction is the best for short spans because it is not so easily knocked to pieces, is it not also the best for longer spans for the same reason? The fact is, to make any pin-connected bridge, whether long or short, safe against accidents which have in the past wrecked other similar structures, is impossible. You may set snubbing posts in line with the trusses and this will probably prevent the end posts from being struck by a derailed train as happened to the Central Bridge Works' bridge on the New York, Ontario & Western Railway at Fish's Eddy in March, 1886. But it would not protect the end-posts against being struck by a projecting stick of cordwood as happened to one of CLARKE, REEVES & CO.'s bridges near Montreal on Aug. 30, 1882. To avoid this you would have to carry the snubbing posts up as high as the tops of the cars. And then these would not protect the bridge against being struck by a steam shovel too high to go under the portal, as happened to another of CLARKE, REEVES & CO.'s bridges on the Canadian Pacific Railway on June 7, 1886. To avoid this you would have to put an overhead frame on top of your high snubbing posts, strong enough to scrape off anything too high to go under the portals. But even then a cow or horse might wander on the bridge and throw the train from the track as in the Baltimore & Ohio accident illustrated by you. You might prevent this by cattle guards at the ends of your bridge. But all this would not prevent a train from jumping the track *on* the bridge and knocking it down, as happened on the Passaic Rolling Mill Co.'s new bridge on the New York, Susquehanna & Western Railroad on Sept. 24, 1886, nor would it prevent a collision on the bridge and consequent distruction of the span, as happened on the Delaware Bridge Co,'s bridge at Port Jervis on the Erie railroad on Oct. 22, 1882, or on the Mississippi river bridge at Des Moines on Jan. 14, 1882.

There is no way to make a pin-connected bridge, whether long or short span, safe against accidents which have destroyed such bridges before. The only safe way is to *build riveted lattice bridges for all spans.* CHAS. F. STOWELL.

[At what particular span it becomes improper to use pin connections, and proper to use riveted structures only, is a problem on which we decline to express a positive opinion, but that 90 ft. is too small a span, we think there would be few or no engineers of standing to dispute to-day. The more important instances mentioned by our correspondent either date back a good while or are affected by a very natural and proper feeling that, whatever a man's private opinion may be as to what is really expedient, it will not do for an engineer seeking practice to attempt any startling innovations on current practice which will increase the cost of structure, however little. The pressure of competition is the most serious obstacle in the way of the general use of heavier and more durable bridges, since it makes it a serious risk for a practicing bridge engineer or bridge builder to take a stand in the matter; the most probable result being that he will simply lose work to less scrupulous competitors, and really accomplish nothing. It is this fact which makes it so desirable, as we think it is, that it should be forbidden by law to erect bridges hereafter which were not proportioned to carry *safely* a *very* much heavier load than they are likely to be subjected to in regular practice. There are difficulties to be overcome in drawing such a law, but we think they can be overcome.

The strongest objection to short-span pin connected bridges, moreover, seems to us to be that their dead weight is so much smaller in proportion to the live, while their articulated form has no tendency to check the excessive vibrations which cannot but result from such conditions. This forbids long life to the structure, but the greater danger of accidental destruction can at least be reduced to a minimum by proper and cheap devices, so that for long spans the pin connection will probably always retain its supremacy, and we cannot see why it should not.—ED. ENG. NEWS.]

Wire Fencing.

M. & N. W. R. R. Co., of Canada. Ch. Eng. Office.
PORTAGE LA PRAIRIE, Man., June 16, 1887.

EDITOR ENGINEERING NEWS:

In reply to D. C. KASEMAN'S inquiry respecting wire fencing, I give the following statement of cost per mile in this country, being actual cost of about 60 miles.

350 posts (includes braces) at 10 cts. each	$ 35.00
1,500 lbs. 4 pointed barb wire, at 6 cts.	90.00
40 lbs. staples at 6 cts.	2.40
Labor	36.86
Freight, superintendence and tools	3.07
	$167.38

Farm gates cost $8.00 each.

The fence posts are oak or tamarac, round, 5 in. diameter at small end, 8 ft. 6 in. long, driven 3 ft. 6 in. in ground, and 16½ ft. centers.

There are four strands of wire, 12, 14, 15 and 16 ins. apart, measuring from ground. making fence 4 ft. 9 ins. high.

We use a fence post driver, being a small pile driver mounted on wheels, the posts being sharpened on one end and cut square on the other.

Yours truly, GEO. H. WEBSTER,
Engineer.

Heavy Rail Sections.

C., M. & St. Paul Railway; Gen. Supt's. Office,
MILWAUKEE, Wis., June 6, 1887.

EDITOR ENGINEERING NEWS:

In a late issue of ENGINEERING NEWS appeared an article again advocating the use of extremely heavy rail sections by railroads.

Without discussing questions involved in the comparative economy of employing heavy rails with wide tie spacing, and light rails with close tie spacing, I will confine myself to a few points which occur to me as against the employment, at present, of such a heavy rail section (100 lbs. per lin. yard).

One claim upon which the heavy rail is recommended, is its supposed great length of life and the large amount of abrasion it would bear.

This I consider an error. Except on curves, or when subjected to much slipping of car wheels, rails can hardly be said to *wear out.* Such examples of excessive rail wear on tangents as were shown in a February number of ENGINEERING NEWS, as taken from the Lehigh Valley Railroad, are far beyond what I have ever observed, and must be rare; and the claim that a 100 lb. steel rail would bear a reduction by abrasion of nearly one-third of its weight, appears to me, in the light of my experience with steel rails of late manufacture, to be preposterous. I have never seen steel rails which by actual measurement showed a reduction in height by wear throughout their length, of more than ¼ of an inch, although it might appear much more, and then had been taken from curves; and I have measured numbers of old failed rails which have been in heavy service from eight to twelve years, which showed a reduction in height of only from $\frac{1}{16}$ to $\frac{1}{8}$ in. Rails rarely wear to the last, uniformly throughout their length, but generally fail by breaking, splitting or crushing at the ends; the last being the most frequent form of failure, and that increasing the weight of the section will not obviate this difficulty, I have seen demonstrated to my satisfaction.

Of the thin standard sections of steel rails of the Chicago, Milwaukee & St. Paul Railway, 56, 60 and 67 lbs. per yard, rails of the lightest section seem to stand wear proportionately the best, being tough and hard and with few defects, while those of the heaviest section have generally proved very unsatisfactory by reason of their extreme softness and consequent liability to crush at the ends. Recently eight miles of 67 lb. steel rail, which had been in use but two years, was removed from track on one of our lines as no longer fit for service, while joining it and sustaining the same traffic, lay a 58 lb. rail which had been in use from eight to ten years and was still in good condition.

From such observations I am led to believe that a rail of 100 lbs. per yard would stand in track but little, if any, better than one of 67 lb . and, consequently, that the extra weight would be so much material thrown away.

This conclusion I base upon my experience with steel rails manufactured within the last six or seven years, during which time, either from the use of inferior material to accommodate a cheap market, or from the employment of improved (?) processes which have damaged the product, these rails have been much inferior to those manufactured prior to that time, and the great *desideratum* now is not so much what should be the weight or form of section of steel rails as that they should at least have the qualities of good iron and not partake of those of lead. A possible explanation of the greater hardness of small rail sections over large ones is that the larger rail, by cooling slower, becomes more annealed.

As to the advisability of using a heavier rail section to give greater rigidity of track under the present heavy rolling stock, I consider the present generally adopted 60 to 70 lb. pattern of rail laid on 3,000 ties to the mile as ample at present, as I fail to see that track is suffering unduly by reason of want of a more rigid rail. If greater rigidity be required, I would recommend increasing the height rather than the weight of the rail.

Yours truly, GEO. B. WOODWORTH,
Supvr. Steel Rail.

[If our correspondent will excuse us for saying so, we think that most of the objections which he raises to heavy rails arise exclusively from the fact that his experience so far has been with the increasingly bad rails which are supplied to nearly all western roads, and to a large majority of eastern roads, owing to the absence of any adequate or real system of inspection. For all external qualities, straightness, absence of flaws, and so on, the inspection on well-managed roads is well enough, but as for the really vital qualities of resistance to abrasion and deformation, there is not only no established test, but there are no means being taken to establish such. Consequently, there being absolutely no check upon the inferior qualities of the rails turned out, manufacturers continue, very naturally and properly, to turn out rails which will pass *the required* inspection (none at all except as to surface) at the lowest possible cost. They do their duty well. It is our correspondent and other officers of the buyers who do not do their duty, by finding out how to tell a good rail when they see it, without waiting ten years to test it in the track, and then accepting only such. Consequently, the quality of rails steadily deteriorates, and with it even

the knowledge of how to make good rails at any price. It is not because cheapness is demanded that the quality of rails deteriorates. It is right and proper that it should be demanded. It is because quality is NOT demanded in the only effectual way, spotting bad rails in advance. The rail inspectors do not even know how to do this if they tried, and few of them try, or are expected to.

A bad steel rail of 100 lbs. section is of course an even poorer investment than a bad 60 lb. rail, but there are quite enough good steel rails made in this country and elsewhere to show that it is easily possible to make them if they are effectually demanded, and that a GOOD steel rail of 90 or even 100 lbs. section is an immensely profitable investment, is beyond all reasonable question. Speaking only of such rails, we may answer our correspondent's points as follows:

1. It is not true that good steel rails will not last till they wear out. There are tens of thousands of tons of steel rails in this country which have worn down more that ¼ in., and we know of at least one large lot which have worn down nearly ⅜ in. by actual measurement, although of only 60 lb. section to begin with, and were in nearly perfect surface at the end. It is all a question of quality.

2. Good steel rails do not "generally fail by breaking or splitting," and as to crushing at the ends, all rails wear down faster at or just beyond the joint than elsewhere, but this is partly due to being too soft (a large majority have been in the past two years) and very largely to their being too flexible at the ends, which greater weight will correct. The remainder of the excessive wear at joints is due to the use of bad and weak forms of joints or to bad ballast, for it is a fact which we have carefully observed and believe to be correct, that with good rails and good track, after a certain amount of surface deterioration has come, it does not increase much, unless the joint becomes bad.

3. The C. M. & St. P. experience with 56, 60 and 67-lb. rails proves nothing. For the reasons stated, they have probably been of increasingly bad quality, as has notoriously been the case with many other roads in the same section.

There is no mechanical or chemical reason why rails of any weight up to 90 lbs. at least should not be of equally good physical quality. As to this, there seems to be no room for doubt whatever, for nearly all English rails are over 80 lbs. per yard, their ties being spaced 3 ft. apart.

5. As to 60 or 70-lb. rails being heavy enough for present requirements, we think if our correspondent were to compare the riding qualities of the light New York elevated rolling stock over 50 and 80-lb. rails he would change his opinion.—ED. ENG. NEWS.]

SOCIETY PROCEEDINGS.

Institution of Civil Engineers.—At the annual general meeting of June 7 the Council reported that on March 31, 1887, there were 4,347 members on the roll, a net increase of 173 over 1886. Of this total number 20 were honorary members, 1,568 members, 2,275 associate members and 484 associates; there were also 949 students. The Institution held 26 ordinary meetings in the year at which 20 original communications were read and discussed. The Council reports having purchased Nos. 24, 25 and 26 Great George street for $75,000, $60,000 and $65,000 respectively, and during the recess they will open communication through the party walls and much extend present office and library accommodations. For the present they have concluded not to enter into any extensive building operations. The ordinary revenue for last year amounted to about $105,075, $86,000 of this being from annual subscriptions and dividends on investments. The general expenditure was $71,245 in which the house charges, including postage, stationary and printing, amounted to 24 per cent.; salaries and wages 20 per cent. and publishing four volumes of the Proceedings, 52 per cent. The ballot for Council resulted in the election of G. B. BRUCE as President and Sir JOHN GOODE, Mr. G. BARKLEY, Mr. H. HAYTER and Mr. A. GILES, as Vice Presidents. The other members of the Council elected were, W. ANDERSON, B. BAKER, J. W. BARRY, Sir HENRY BESSEMER, E. A. COWPER, Sir JAMES N. DOUGLASS, SIR DOUGLAS FOX, C. HAWKSLEY, J. MANSERGH W. H. PREECE, Sir ROBT. RAWLINSON, Sir E. J. REED, W. SHELFORD, F. C. STILEMAN and Sir WM. THOMSON.

List of Members and Guests who had signified their intention to be present at the Annual Convention of the American Society of Civil Engineers up to June 21.

J. ARCHBALD and Miss ARCHBALD, Scranton, Pa., O. W. BARNES and two ladies, Mr. and Mrs. W. H. BURR, Phœnixville, Pa.; Mr. and Mrs. A. BONZANO, HUBERT BONZANO, Phœnixville, Pa., G. BOUSCAREN, Cincinnati, Ohio,; Mr. and Mrs. T. E. BROWN, Jr., and Mrs. T. E. BROWN, New York; Mr. and Mrs. GEO. BURNHAM Jr., Philadelphia, Pa.; Mr. and Mrs. C. P. E. BURGWYN, Richmond, Va.; Mr. and Mrs. THOS. W. BALDWIN, Bangor, Me.; Mr. and Mrs. W. S. BARBOUR, Cambridgeport, Mass.; R. BASSEL, Technical Attaché, Imperial German Legation; A. P. BOLLER and Miss BOLLER, New York; Mr. and Mrs. JOHN BOGART and Miss HARRIS, New York; JOHN H. BOGART, New York City; Prof. C. N. BROWN, Columbus, Ohio; FRED. BROOKS, Boston, Mass.; Mr. and Mrs. AMORY COFFIN and Miss GRIFFEN, Phœnixville, Pa.; F. A. CALKINS, Brooklyn, N. Y.; J. J. R. CROES and Miss CROES, Yonkers, N. Y.; Mr. and Mrs. MENDES COHEN, Baltimore, Md., W. D. CHAPMAN, Akron, Ohio; ROBT. CARTWRIGHT, Rochester, N.Y.; Mr. and Mrs. THOS. C. CLARKE, New York; C. G. CURTIS, Miss E. G. CRANS, THEODORE COOPER, E. B. DORSEY, New York; Mr. and Mrs. FRED. DE FUNIAK, Louisville, Ky.; Mr and Mrs. F. G. DARLINGTON, Mrs. E. A. GREENE, Miss. E. BUCKINGHAM, Zanesville, Ohio; J. S. DEANS, Phœnixville, Pa.; J. F. DAVIS, New York; E. P. DAWLEY, Providence, R. I.; E. W. ECKERT, New York; M. T. ENDICOTT, Norfolk, Va.; Mr. and Mrs. G. H. FROST and son, New York City; CLARK FISHER, Trenton, N. J.; Mr. and Mrs. C. E. FOGG and sister, Poughkeepsie, N. Y.; Mr. and Mrs. J. F. FLAGG and daughter, New York City; A. J. FRITH, Columbus, Ohio; Mr. and Mrs. H. C. FELTON, Camden, N. J.; D. FITZGERALD, Brookline, Mass.; Jos. FRILLEY, Chief Engineer U. S. Navy; Mr. and Mrs. E. M. GRAY, Providence, R. I.; Mr. and Mrs. WM. GIBSON, New York; Mr. and Mrs. E. B. GUTHRIE, Buffalo, N. Y.; Mr. and Mrs. FRED. GRAFF, Philadelphia, Pa.; Gen. Geo. S. GREENE, G. S. GREENE, Jr., and CARLTON GREENE, New York; A. M. GOODALE, WM. G. HAMILTON and two sons, New York; Mr. and Mrs. A. E. HUNT, Pittsburg Pa.; Mr. and Mrs. F. B. HOWARD, Detroit, Mich.; Mr. and Mrs. E. HAYES and sister, Buffalo, N.Y.; C. F. HAYNES, Boston, Mass.; WASHINGTON JONES, Philadelphia, Pa.; W. H. JENNINGS, Columbus, O.; Mr. and Mrs. J. B. JOHNSON, St. Louis, Mo.; WM. B. KNIGHT, Kansas City, Mo.; Mr. and Mrs. E. KUICHLING, Rochester, N. Y.; C. F. LOWETH, St. Paul, Minn.; H. H. LATHAM, Chicago, Ill.; Mr. and Mrs. T. B. LEE, New York; Mr. and Mrs. C. C. MARTIN and Miss MARTIN, Brooklyn, N. Y.; Mr. and Mrs. CHAS. MACDONALD, New York; T. C. MCCLEOM, Philadelphia, Pa.; Mr. and Mrs. ROBT. MOORE, St. Louis, Mo.; Mr. and Mrs. H. G. MORSE and Miss MORSE, Youngstown, O.; Mr. and Mrs. GEO. E. MANN, Buffalo, N. Y.; D. E. MCCOMB, Washington, D. C.; R. E. MCMATH, St. Louis, Mo.; JAS. MACNAUGHTON, Albany, N. Y.; Prof. MANSFIELD MERRIMAN, Bethlehem, Pa.; Mr. and Mrs. ED. P. NORTH and Mrs. H. C. MEYER, New York; Mr. and Mrs. E. B. NOYES, Fort Edward, N. Y.; J. A. OCKERSON, St. Louis, Mo.; J. F. O'ROURKE, Poughkeepsie, N. Y.; Mr. and Mrs. S. B. OPDYKE, New Haven, Conn.; Mr. and Mrs. F. C. PRINDLE, East Orange, N. J.; GEO. H. PEGRAM, North Scituate, Mass.; PERCIVAL ROBERTS, Jr., Philadelphia, Pa.; Prof. P. C. RICKETTS, Troy, N. Y.; Mr. and Mrs. P. S. REEVES, Philadelphia, Pa.; WM. ROBERTS, Waltham, Mass.; Mr. and Mrs. B. F. RICHARDSON, J. L. RINGWALT, Editor *Railway World* Philadelphia, Pa.; Mr. and Mrs. JOS. R. RICHARDS, Boston, Mass.; D. MCN. STAUFFER, New York; Mr. and Mrs. F. P. STEARNS, Boston, Mass.; Mr. and Mrs. T. GUILFORD SMITH, Buffalo, N. Y.; H. B. SEAMAN, Philadelphia, Pa.; Mr. and Mrs. JOHN THOMPSON, New York; Mr. and Mrs. ROGER TAPPAN, Haverhill, Mass.; A. W. TROTTER, New York; M. M. TIDD and two ladies, Boston, Mass.; CALVIN TOMKINS, STEVENSON TOWLE and three ladies, New York; Mr. and Mrs. GEO. C. TINGLEY, Providence, R. I.; Mr. and Mrs. R. H. THURSTON, Ithaca, N. Y.; H. LEE VAN ZILE, Albany, N. Y.; Mr. and Mrs. W. H. WILEY, Mr. and Mrs. A. M. WELLINGTON, Mr. and Mrs. W. E. WORTHEN, S. S. WHEELER, New York; Mr. and Mrs. J. R. WAKDLAW, Yonkers, N. Y.; W. W. WALKER, Cedar Rapids, Iowa; Mr. and Mrs. C. D. WARD, Oswego, N. Y.; Mr. and Mrs. JOS. M. WILSON, Mr. and Mrs. HENRY W. WILSON, Philadelphia, Pa.; S. T. WAGNER, Phœnixville, Pa.

Sixth Annual Convention of the New England Water Works Association.—At the evening session on the 15th, the Committee on Distribution of Sketches reported and recommended the discontinuance of the Committee. The apathy of members in regard to furnishing sketches was so great that the above action was considered necessary although regrettable. The subject was discussed at this meeting and also on the following evening session and a trial of another year is to be made. A paper on the "Fall River Water Tank" was read and considerable discussion on the methods of setting the bottom of large tanks on their foundation was elicited. Asphalt Varnish, applied hot and used about once in three years was considered best for tanks. Ice in tanks and lining of tanks was also discussed. A very long and interesting report by A. H. Howland, on the Classification of Water Rates was read. The sum and substance of it all was that meters would give the most satisfactory returns to Water Companies. The subject is an interesting one and was discussed at considerable length. In Pawtucket, R. I., the water costs the city $11 per million gallons, and at lowest rates of 6 cents per 100,00 gallons to large consumers, they sell it at $66 thus ensuring a good balance to be applied to extinction of funded debt and for further extension.

The following were elected officers for the ensuing year at the meeting on Thursday.

President—EDWIN DARLING, Pawtucket, R. I.

Vice Presidents—DESMOND FITZGERALD, Boston, WILLARD KENT, Woonsocket, CHARLES K. WALKER, Manchester, F. H. PARKER, Burlington, Vt., GEORGE P. WESCOTT, Portland; J. C. BROATCH, Middleton, Conn.

Secretary—R. C. P. COGGESHALL, New Bedford.

Treasurer—A. S. GLOVER, West Newton.

Senior Editor—GEORGE F. SWAIN, Boston.

Junior Editor—WM. B. BILLINGS, Taunton.

Executive Committee—F. E. HALL, Quincy, Mass.; WALTER H. RICHARDS, New London, Conn.; A. F. NOYES, West Newton.

Finance Committee—GEO. E. BATCHELDER, Worcester; PHINEHAS SPRAGUE, Malden; JAMES H. HATHAWAY, New Bedford.

A salary of $300 per year was voted to be allowed to the secretary.

The treasurer's report showed the gross receipts of the year have been $1,639.14, and the expenditures $1,067.14, leaving a balance on hand of $572, with $.00 more in good out-standing bills. The association derives its revenue from dues and the publication of a monthly journal, the advertising in which brought in over $900 last year.

Papers according to programme were read and after the afternoon session a drive around the city was taken.

On Friday the Association was the guest of the City of Manchester and an excursion by land and water with the usual liberal refreshments provided was given.

The next annual meeting will be held at Providence, R. I. It is a satisfaction to note this action on the part of the association. The hotel accommodations at Manchester were most unsatisfactory and as it has been abundantly demonstrated that the average New England hotel in cities of the size of Manchester cannot comfortably provide for an immediate inroad of 125 extra guests, so it was considered advisable to seek accommodations in the larger cities. There is no doubt that good food, well served and above all a comfortable bed to spend the night in are important elements to the success of any gathering such as these conventions are. If men come to the meetings weary in body and mind, hungry and sleepy, they cannot be expected to feel much enthusiasm over the subject in hand. It is simply the national disposition that allows the average American to submit to the regular imposition of the average inn keeper. Americans are the most patient and submissive people in the world: if there is any part of America where good hotels should be the rule and not the exception, it is in New England, and it is the duty, an absolute obligation of a body of men such as met in Manchester last week, to express their feelings of dissatisfaction where they are not properly treated.

June Meeting of the American Society of Mechanical Engineers held in Washington, D. C.

(*Concluded from page 401.*)

After the "convenient lunch" the afternoon session was resumed and the following papers were read and discussed:

"Steam and Power, the Commercial Determination of Costs," by HENRY R. TOWNE. This consisted of a series of tables showing the cost of steam and power used in the Yale & Towne Manufacturing Co. during the month of January, 1887, and an explanation of how the results were obtained. The total cost of steam was $670.35 and that of power $281.19. Mr. WM. KENT'S "Problem in Profit Sharing," followed. This was a plan to divide among the workmen the money saved by more rapid work and economy in the use of the material. He also proposed to apportion the losses from these causes among them. That the workmen would assent to the first part there is no doubt, but when the second portion was enforced, the writer thinks "strikes" would be the order of the day.

That evening the Hon. JOSIAH DENT gave an elegant reception to the Society at his residence. This place is situated in Georgetown and the grounds attached to the house are enchanting. Large trees shade the house, which is on the summit of a hill, and it is remarkably attractive and picturesque in its appearance. The house is one of the Colonial period and it was here that LA FAYETTE was entertained by JOHN C. CALHOUN. Had the former only challenged the latter to a duel and used on him that graceful sword he holds in his hand on

his monument in Union Square, and had he passed this weapon a few times through Mr. CALHOUN, the probabilities are that our late Civil War would not have occurred, but the reality of the case referred to probably was that the Marquis and Mr. CALHOUN joked, exchanged ideas of statesmanlike character, and got drunk together in real old Colonial fashion. The Society, however, being temperance (not abstinence) men, simply enjoyed Mr. DENT'S hospitality to its full extent, and had the pleasure of meeting many of Washington's real solid men, not congressmen or politicians, but gentlemen, and we were also favored by the presence of many charming Washington ladies; some of the belles, especially the goddess who presided over the punch bowl.

The trip to Mt. Vernon the next day was all that could be desired, and the planked shad at MARSHALL'S plantation will not soon be forgotten. The members were reduced almost to a state of starvation owing to certain delays, and had the shad been much longer in coming it is feared that cannibalism would have ensued. After all, a cannibal is a true philanthropist, for he loves his fellow man.

That evening "The Needs of our Navy" were set forth by Mr. H. A. RAMSAY. This subject was extremely interesting from one point of view, for it assumed that we actually had a navy and that it needed something. We have been told all along that we had no navy and no doubt all rejoiced at once to find this was a slander. The needs of the navy were fast cruisers and torpedo boats, and the writer seemed hopeful that we would get them by degrees, but wisely forbore to make any predictions as to when. However, the navy yards always fill up with men in a remarkable manner, just before election, and in the present case no doubt they will be filled with ships as well. Mr. RAMSAY also recommended three powerful steel armored vessels for defending the coast against foreign iron-clads. There were several navy officers present and it had been expected they would discuss this and the next paper but they sat "as mute as fishes," they had evidently come to learn and not to teach.

The paper following was somewhat akin to Mr. RAMSAY'S, only more extended in its scope: "Our Coast Defence, its Cost and its Mechanical Problems," by JOS. MORGAN, Jr. He considered the work to be done consisted of: "Construction of Foundations and other Masonry and Earth Works for the Protection of Guns and Appurtenances;" "Armor Protection for the same;" "Structural Metal and Machinery for Mounting and Working the Turrets and Guns;" "Construction of Guns and Carriages;" "Building of Armor Clad Vessels;" "Installation of Sub-Marine Mines;" "Torpedo Boat Defence."

As to cost, the estimate to protect 27 ports was $126,377,800, or about $2.52 per head for our population. In eight of the principal seaports where the destructible property is $4,500,000,000 a 2 per cent. tax would suffice to protect them. As it would take 10 years to build these pits, he thought they should be begun *at once*. And he is quite right, unless the United States reasons as did the Irishman: "Why don't you mend your leaky roof?" "Because be dad, it rains too hard." On a pleasant day he was asked "Why don't you mend it now?" "Because divil a bit of rain comes in." This has been the course of reasoning in the United States viz. There is no foreign war, therefore no need of fortifications, and when it does come, then it will be too late. This policy is so plainly criminal neglect that it needs no argument, and while the political parties strive for some miserable advantage over each other, 4,500 million of dollars lie at the mercy of some fourth-rate power who has an ironclad fleet, and whose whole territory would be no return adequate for the damage they could inflict on us. If Mr. MORGAN'S words will arouse the nation to such patriotic utterances that no Congressman will dare neglect them, then this whole meeting, if it does not accomplish another thing, will have proved the greatest possible benefit to the country, and the "benedictions" alluded to before, will have been fairly earned.

The next day, the party visited Cabin John bridge, a structure so remarkable that it is worthy of pictorial representation, and we consequently reproduce it from an excellent photograph secured in Washington.

This bridge, situated about 5 miles from Washington, is a single span of stone, rising to the

The Weather of the United States for the Month of May, 1887.

[As respects the elements of most interest to engineers.]

According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	Temperature. Degrees Fah.				Wind Velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Heaviest in 24 hours.	No. rainy days.
NORTHERN CITIES.										
Northfield, Vt.	58.9	84.1	29.0	55.1	8.3	30	N	1.39	0.46	8
Portland, Me.	55.7	86.8	41.0	45.8	7.7	28	NW	1.93	1.34	10
New York City.	62.9	72.6	55.2	17.4	5.1	16	N & S	0.99	0.50	5
Pittsburg, Pa.	68.2	95.1	47.4	47.7	5.2	24	S	5.78	2.24	15
Chicago, Ill.	59.4	85.7	42.3	43.4	8.9	44	SW	1.38	0.49	7
Omaha, Neb.	66.1	93	39.2	53.8	9.9	34	NW	1.39	0.79	11
St. Paul, Minn.	64.1	91.1	36.9	54.2	7.9	36	S	1.60	0.68	9
Duluth, Minn.	49.0	80.4	35.1	45.3	5.9	28	NW	4.93	3.27	9
Bismarck, Dak.	59.0	90.6	25.7	64.9	9.2	40	N	2.19	0.77	11
Average	60.4	86.6	39.1	47.5	8.6	31		2.40	1.17	9.4
SOUTHERN CITIES.										
Washington City.	67.9	88.7	50.2	38.5	4.2	30	W & NW	2.50	0.76	10
Louisville, Ky.	70.9	90.3	53.9	36.4	5.6	24	SW	2.12	0.51	14
St. Louis, Mo.	71.4	89	51.1	37.9	6.3	28	SW & N	5.27	1.55	15
Savannah, Ga.	72.5	89	66	23.0	7.4	23	NE & E	2.73	0.91	11
Leavenworth, Kan.	67.9	89.6	45.0	44.6	6.5	30	S	3.07	0.79	12
Jacksonville, Fla.	73.6	91.3	55.3	36.0	7.3	28	S	7.15	2.72	14
Chattanooga, Tenn.	70.8	90	52.8	37.2	4.4	33	S	6.57	1.80	15
New Orleans, La.	75.2	90.9	62.1	28.8	7.0	24	SE	3.99	1.49	9
Memphis, Tenn.	73.2	90.5	54.0	36.5	5.1	36	NW	2.83	1.23	14
Palestine, Tex.	72.1	91.9	46.5	45.4	8.2	31	NE	6.76	3.84	11
Average	79.5	90.1	53.7	36.4	6.2	28.7		4.30	1.56	12.5
FAR WESTERN CITIES.										
Helena, Mont.	51.5	88.1	30.7	57.4	8.2	30	W	2.41	0.76	9
Port Angeles, W. T.	49.6	73.8	30.4	43.4	5.6	29	EW	2.11	0.79	12
San Francisco, Cal.	55.8	96.9	45.6	51.3	11.1	32	W	0.06	0.03	3
Salt Lake City, U.	60.4	93.3	30.7	62.6	6.6	29	S	0.73	0.33	3
Denver, Col.	59.5	89.4	30.9	58.5	7.6	28	S	1.13	0.85	5
Yuma, Ariz.	77.2	103.5	44.5	59.0	6.9	28	W	Inappreciable.		0
Santa Fé, N. M.	Not yet received.									
Average	59.0	90.8	35.5	55.4	7.7	29.3		1.07	0.46	5.3

neight of 101 ft., and its clear span is 220 ft. It is built of immense blocks of granite, and the parapets and coping are of Seneca sandstone. The rise from the springing line is 57½ ft. Its width is 20 ft., and the extreme length 420 ft. It serves to carry the aqueduct across Cabin John creek. The cost of the structure was $237,000, and it has the honor of being the largest stone arch in the world. It was put up when the late (for he certainly is dead) JEFFERSON DAVIS was Secretary of War, and for a time his name appeared on the tablet, but during the Rebellion, some zealous patriots had this removed that the eyes of Northern men might no longer be offended by the sight of this traitor's title. Some weak-kneed brethren may think this harsh and desire it replaced just as at one time an effort was made to erase from the bloody battle flags of our heroic soldiers the names of Antietam, Wildernesss, Chicamauga, etc. Should these milk and water people who probably never heard a gun fired except for a salute, and who stayed at home during the nation's struggle, ever succeed in replacing the name, the writer trusts that alongside of it may appear that of BENEDICT ARNOLD, whom no doubt these same parties would consider a well-meaning but somewhat mistaken hero (?) of our Revolution.

THOS. S. CRANE then contributed a paper entitled "Direct Acting Vernier Cutters." This was the invention of Dr. H. S. SMITH, of Brooklyn, and by it he avoided the use of the machinery and gearing usually employed since the knife was actuated by direct connection with the steam piston. The machine cut to $\frac{1}{10}$ in. The paper was illustrated by diagrams of the machine and its attachments.

Mr. GEO. H. BABCOCK, President of the Society, followed with a paper "New Method of Making Tubes from Solid Bars."

That he made them in this way was evident, for samples were shown at all stages of progress. The solid bar being at one end and the tube at the other, the rolls by which this process was accomplished were set at an angle to each other, and the tube was evolved. Just how this was accomplished the writer failed to see; either he was not wide-awake enough to grasp the business end of the manufacture, or Mr. BABCOCK, either by accident or design, failed to make him see it. As a matter of personal pride, he prefers the latter hypothesis, but the solution is, however, open to the former objection. That these tubes were made, he is ready to aver, for he *saw* them. A man may doubt his ears but never doubts his eyes.

The concluding paper of the session was on "Incandescent Gas Lighting," and was contributed by one of our honorary members, Mr. JAS. DREDGE, of London. The paper would undoubtedly have been as brilliant as its title, for the author had taken great pains to send apparatus to exhibit the progress made in this investigation. The writer had seen some of the experiments, and they opened a wide field for research. Unfortunately the entire outfit was on the unlucky *Celtic*, and it had proved impossible to get it out in time to exhibit. A short abstract of the paper was read, but there was nothing to discuss, for those present were not at all familiar with the subject.

Topical Discussions followed which afforded everyone a chance to tell what he knew and what he did NOT know, and moreover gave each person an excellent opportunity to prove it. These were as follows:

TOPICAL DISCUSSIONS.

39. What have you found the best methods for removing gas and smoke from blacksmith shops—*Halsey.*

40. What is the best cross section for the frame of a steam engine—*Halsey.*

41. What data can you give from your experience as to the working pressure of gear teeth—*Halsey.*

42. Is there a form of safety valve on the weight and lever principle suitable for boilers on small vessels in rough water—*Cowles.*

43. Is 6,000 lbs. per sq. in., as provided in the United States Inspection Laws for steam vessels, a necessary limitation for stays in marine boilers—*Cowles.*

44. What system of regulating the wages of labor in our manufacturing establishments will tend to make that labor most efficient and produce the largest returns both to employer and employé. Give especially data from actual experience with effects of piece-work, premiums, participation in profits, graduation of wages, with terms of service, etc., etc.—*Kent.*

45. What is the best method and form of tool for drilling small deep holes in steel; say a hole ¼ in. in diameter drilled 4 ft. into end of a steel shaft—*Towne.*

46. Have you made any use of calculating machines or tables, either in professional or commercial work: if so with what results—*Towne.*

47. What limit of stress should be adjusted for chain as used on cranes—*Towne.*

48. What is the average efficiency of a man when turning a crank:—Have you any data based on actual experience—*Towne.*

49. What is the average loss of efficiency from friction in ordinary hoisting machines operated by hand—*Towne.*

The session then concluded with the following vote of thanks:

Resolved, That the thanks of the society are due and are hereby tendered to the Local Committee for their very efficient and admirable arrangements by which the interest and success of the meeting have been promoted and our visit to their beautiful city made a pleasure to be long remembered.

Resolved, That the Society tender their special thanks to the HON. JOSIAH DENT and to his son, Mr. EDWARD L. DENT, for their kind hospitality in bringing together the members of the Society and prominent citizens of the City of Washington, by their evening reception in their homelike and historic mansion.

CHAS. T. PORTER,
DAVID TOWNSEND,
Committee.

PERSONAL.

Mr. ROBERT LEWIS DAVIS, formerly connected with the engineering staff of the Mexican Central Railway, and more recently with a mine in Zacatecas, is requested to communicate his address to this journal.

MR. ALFRED GOOCH, son of Sir DANIEL GOOCH and Resident Engineer of the Severn Tunnel from its commencement 14 years ago, died at Chepstow lately.

W. G. VAN VLECK has been appointed Superintendent of the Louisiana division of the Southern Pacific R. R., to succeed J. C. BUCHANAN, who has resigned.

JAMES CARTON, Section Inspector on the Jeffersonville, Madison & Indianapolis R. R., with headquarters at Indianapolis, Ind., has been appointed Roadmaster of the Gulf, Colorado & Santa Fé R. R., with headquarters at Fort Worth, Tex. He will be succeeded on the J. M. & I. R. R. by T. GILHOOLY.

O. H. TRIPP, of Rockland, Me., Chief Engineer of the Camden, Rockport & Rockland R. R., is pushing the preliminary survey for the line. His assistants are F. E. HULL, of Warren, Me., transitman, and A. CORLISS, of Bath, Me., leveler.

MR. JAMES B. FRANCIS, Past President Am. Soc. C. E., sails from Boston for Liverpool, on the 20th inst., to be abroad some months.

CHANGES OF ADDRESS, MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

A. P. BARNARD, U. S. Coast Survey, Lawrence, Kan.

GEO. B. CORNELL, Chief Engineer, Union Elevated R. R., 31 Sand street, Brooklyn, N. Y.

JAS. C. POST, Major Corps of Engineers, U. S. A., Washington, D. C.

C. D. PURDON, Grand Town, Ill.

H. T. RICHARDS Assistant General Manager Sonora R. R., Guaymas, Sonora, Mexico.

F. M. RUTHERFORD, Assistant Engineer and Roadmaster, Atlantic & Anniston R. R., Anniston, Ala.

JAS. D. SCHUYLER, Chief Engineer National City Water Works, San Diego, Cal.

GEO. E. THACKARY, P. O. Box 788, New York City.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 402.

Nebraska City, Neb.—The works were commenced May 15, 1887, and will probably be finished by Sep. 15; they have been delayed by the pipe not being delivered as per contract. They were designed by Col. S. H. LOCKETT, Chief Engineer, and E. A. RUDIGER is Constructing Engineer. The contract for the entire work was taken by Comegys & Lewis, New York; the contractors for separate work were as follows: Masonry and foundations, Joseph Burr, Nebraska City; brick work of buildings, Prue & Driscoll, Nebraska City; pumping machinery, Pond Engineering Co., St. Louis, Mo.; pipe, specials and stand-pipe, Shickle, Harrison & Howard Iron Co., St, Louis, Mo.; valves and hydrants, Ludlow Valve Co., Troy, N. Y. The trenching, pipe laying and reservoir were done by days work. The stand pipe is 12.5 ft. diameter and 100 ft. high; its top is 231 ft. above the floor level of the pump room. There will be 8 miles of mains, with 80 hydrants; 3,276 lin. ft. of 12-in. pipe, 1,772 ft. of 10-in., 5,448 ft. of 8-in., 22,652 ft. of 6-in., 9,060 ft. of 4-in. The water will be taken from the Missouri river and will be filtered by Hyatt filters; a clear water basin of 700,000 galls. capacity will be built at the pumping station to store filtered water until it is required. The pumping plant will consist of two Worthington pumps with a daily capacity of 1,000,000 galls. each; there will be two tubular boilers, 60 ins. diameter and 16 ft. long, and the brick chimney is 70 ft. high, 42 ins. diameter, octagonal. The stand pipe is 6,000 ft. from the pumping station. The domestic service is by stand-pipe pressure, and the fire service by direct pressure. The franchise requires the company to furnish four fire streams 80 ft. high from any four hydrants in the city through 300 ft. of 2½-in. hose and from a 1-in. ring nozzle. The meter rates will be 3½ to 1½ cts. per 100 galls. The franchise is owned by the City Water Co.; President, D. P. ROLFE; Secretary and Treasurer, J. W. MAGUIRE. The franchise is for 20 years, and the annual rental is $50 per hydrant. The present population is estimated at 9,000.

Mount Vernon, Ind.—The works were commenced in May, 1886, and accepted in December; W. S. KUHN was the engineer. The contract for the entire work was taken by the American Water Works & Guarantee Co., Muncie, Ind. The stand-pipe is 16 ft. by 130 ft. The franchise is owned by the American Water Works & Guarantee Co.; it is for 30 years and the hydrant rental is $50. The works are controlled by the Mount Vernon Water Co.; President, W. S. KUHN; Secretary and Superintendent, J. H. PURDY. The present population is estimated at 4,000.

Kingman, Kan.—The works were commenced in November, 1886, and will be completed this month; they were designed by F. W. RAEDER, and N. W. PERKINS is Constructing Engineer. The contract was taken by the Water, Light & Power Co., St. Louis, Mo.; the pumping machinery was supplied by Gordon & Maxwell, Hamilton, O.; the pipe and specials by the Shickle, Harrison & Howard Iron Co., St. Louis, Mo., and the valves and hydrants by White and the Ludlow Valve Co. The tank is 113 ft. high. The franchise is owned by the City of Kingman Water & Power Co.; President, M. W. CONKLING, New York; Secretary, J. G. CONKLING, Kingman, Kan. The franchise is for 30 years and the hydrant rental is $70, and $25 on extensions. The present population is estimated at 5,000.

(TO BE CONTINUED.)

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

CONSTRUCTION NEWS.

Water.

Washington, D. C.—Another break in the mains has occurred recently owing to the settling of the pipes in the made ground.

The Hyatt Filter System has been adopted by the City Water Co., Nebraska City, Neb. There will be two filters, with a daily capacity of 150,000 galls.

The Binghamton Hydraulic Power Co. has been incorporated at Binghamton, N. Y., with a capital stock of $25,000, to manufacture water motors under patents granted to CHAS. E. VAN DUSEN, of Oneonta, N. Y. D. W. GREGG is Secretary and Treasurer.

Sewerage.—Fort Collins, Col. Maj. STOLBRAND, City Engineer, is surveying for a system of sewerage.—Lincoln, Neb. Bonds for $20,000 are to be issued for sewers.—Riverside, Cal. Three miles of main sewers are nearly completed and four miles of lateral sewers are to be built.

Albany, N. Y.—The plans of the new water commission for supplying water from driven wells on the Van Rensselaer flats and from reservoirs formed by erecting dams on Patroons creek and Sand creek, near West Albany, have been sent to the old commission and by them turned over to their engineer, Mr. MARS, for a report.

Water Meters.—At New London, R. I., the proposition to place meters in private houses meets with great disapproval. The new rules of the Water Board, which will be submitted at the July meeting of the Court of Common Council, include a clause giving the Commissioners the right to put meters where they please and to assess the premises for 10 per cent of the cost of the meter.

The Westinghouse Electric Co. is meeting with an enormous demand for the alternating system for central station work. The shops employ about 1,200 men, and are working a night gang. The lamp factory is already the largest in the United States. There are now over forty stations under construction or in operation. Recent contracts have been made in Pittsfield and Springfield, Mass.; Hartford, Conn.; Denver, Colorado Springs and Ouray, Col.; St. Louis, Mo.; Cornwall, Canada; Littleton, N. H.; Portland, Me.; Morristown, N. J.; Staten Island, N. Y.; Galveston, Tex., and Charleston, W. Va.

Newark, N. J.—ERNEST ADAM, City Surveyor, has issued his report for 1886. For street paving and repaving, $50,000 were raised by taxes, and expenditures amounted to $48,707.80. Oblong trap blocks are recommended for paving the less prominent streets. Grading and curbing cost $4,902.21. Of sewers there were 16,026 ft. constructed, and 37 basins built. Two draw-bridges were built across the Peddie street ditch at a cost of $800. The annual contract for dredging in the Passaic river was taken by Ross & Sanford, Jersey City, at 63 cts. per cu. yd.; the high rate being due to the long haul, about 5 miles, to the government work at Newark bay. There are now 61.465 miles of sewers, 1,477 receiving basins and 1.85 miles of private sewers.

Allentown, Pa.—Upon the recommendation of the Water Board, Councils recently passed an ordinance appropriating $50,000 to abandon the present water-works and build new works near the spring, and at the last election it was decided to increase the bonded debt $50,000 to meet the expenses. Considerable opposition was developed and as a result a bill in equity has been filed against the city officers and the Water Commissioners praying that the Court declare illegal and void all ordinances and resolutions relating to the water-works and increased debt questions.

New Water Works.—Boothbay, Me. Water-works are contemplated. Address A. R. Nickerson.—Waterville, Me. Operations will be commenced as soon as the pipe is delivered.—Foxcroft, Me. Work has been commenced on the Dover and Foxcroft water-works.—In the New Hampshire Assembly the bills to incorporate the Claremont Water-Works, and the Wolfesborough Aqueduct & Water Co. have been ordered to third reading.—Montrose, Pa. Application will be made on July 5 for a charter for the Montrose Water Co.; the incorporators are JAS. R. DE WITT, Jr., GEO. S. JESSUP, B. K. JAMISON, JOHN A. WILSON and J. HENRY KERSHAW.—Baton Rouge, La. H. S. RAYMOND, of the Chicago Water-Works Construction Co. has written to the Mayor to the effect that the works will certainly be built, but that they will not be commenced before September.—Sturgis, Dak. The council is considering the question of establishing water-works.—Fredonia, Kan. The 10-in. mains are being delivered; the water will be taken from Fall river, 1½ miles distant, and pumped to a reservoir with an elevator of 150 ft. JAS. A. O'NEIL owns the franchise.—Silverton, Col. It is proposed to issue bonds for the purchase of the existing works.—Loveland, Col. The works are nearly completed.—Norfolk, Neb. It has been decided to grant a franchise for water-works. A. L. STRONG, of Omaha, made a proposition to put in a combined stand-pipe and direct pressure system, with 50 hydrants; the city to pay a rental of $3,000 per annum, and to grant a franchise for 25 years.—Chadron, Neb. Water-works are proposed, the gravity system will be adopted.—Bowie, Tex. The city will issue bonds for $4,000 for an artesian well and water-works.—Burnet, Tex. Address A. R. JOHNSON.—Lovely Mount, Va. Address the Radford Improvement Co.—Windsor Locks, Conn.—Carey, O.—Greensboro, N. C.—Clinton Wis.—Loup City, Neb.—Seguin, Tex.

Proposals Open.

Water Pipe.—Cast-iron pipe; 900 lengths of 6-in pipe, 60 lengths of 8-in. and 40 lengths of 16-in. Bids per ton of 2,240 lbs. Specifications at the office of the Chief Engineer. JOHN WATT, Chairman of Committee on Extensions and Distributions, Board of Public Works, Jersey City, N. J. June 27.

Sewers.—Vitrified salt glazed 12-in. drain pipe, flushing tank, basins and manholes. JOHN HUNKELE, Street Commissioner, Newark, N. J. June 28.

Drainage.—Construction of the Forbes drainage works; consisting of dredging, buildings and machinery for the drainage, by embanking and pumping, of 5,000 acres of marsh land at Tilbury East, Ont. Plans and specifications at the office of the township clerk and at the office of A. MCDONELL, C. E., Chatham, Ont. D. R. FARQUHARSON, Township Clerk of Tilbury East, Fletcher P. O., Ontario, Canada. June 28.

Sewers.—PERCIVAL W. ST. GEORGE, City Surveyor, Montreal, Canada. June 28.

City Work.—Main sewers, branch sewers and street grading. LOUIS WAGNER, Director, Bureau of Surveys, Department of Public Works, Philadelphia, Pa. June 28.

Steam Heating and Ventilating Apparatus.—For court house. Plans and specifications at the office of DANIEL RYAN, Superintendent of Construction and Repairs. THOMAS B. WATSON, Chairman, Committee on Court House, Room 13, County Court House, Brooklyn N. Y. June 30.

Water Meters.—Proposals for 5,000, 10,000 and 15,000. Specifications at the office of the company. WILLIAM NORRIS, Secretary, Spring Valley Water-Works Co., San Francisco, Cal. July 1.

Bulkhead.—Crib bulkhead at the foot of E. 76th street, East river. Yellow pine timber, piles, crib logs, iron spikes, bolts, etc., crib stone, rip-rap, earth filling, excavation, labor. THE DOCKS COMMISSIONERS, Department of Docks, Pier A, North river, New York City. July 1.

Bridge.—Length 100 ft., width 16 ft. C. E. WINGFIELD Washington, Ga. July 2.

Water Pipe.—Water main, 2,500 ft. to connect with the artesian well. Four separate bids requested; for 6-in., ⅜-in. shell, cast-iron pipe; for 6-in. kalamein pipe; for 8-in., ⅜-in. shell, cast-iron pipe; for 8-in. kalamein pipe. Each bid to include one 6 or 8-in. T, one 6 or 8-in. valve, one 6 or 8-in. iron gate box, six 6 by 6, 4 by 4, or 8 by 8, 6 by 6 crosses, two 6 or 8-in. plugs, 12 4 or 6-in. plugs, seven 6 by 6 or 8 by 8 Ts, 4-in. branch, seven hydrants 8 ft. long, 100 ft. of 4-in. pipe connecting hydrants with main; all necessary lead and yarn. Bottom of trench 8 ft. below surface. THE WATER WORKS COMMITTEE, care of J. M. GRAHAM, Mayor, Jamestown, Dak. July. 5.

Sewer.—Vitrified 15-in. pipe sewer 310 ft.; 1,285 ft. of 21-in. brick sewer, 5 receiving basins, 30 cu. yds. concrete, 800 cu. yds. rock excavation. PEARL C. HILLIARD, Chairman of Committee on Streets and Sewers, Board of Public Works, Jersey City, N. J. July 5.

Paving and Curbing.—Plans and specifications on file in the office of the City Clerk. MICHAEL REIS, Mayor, Belleville, Ill. July 5.

Steel Gun Forgings.—Ten sets of steel forgings for 6-in. B. L. rifle guns and one set of chase hoops for a 10-in. B. L. rifle gun, all oil treated, annealed and in accordance with drawings and specifications in the Bureau of Ordnance. Prices per ton of 2,240 pounds. Hon. WILLIAM C. WHITNEY, Secretary of the Navy, Navy Department, Washington, D. C. July 6.

Iron Fence.—About 540 ft. of three-rail wrought-iron picket fence, 4 ft. high, with 3 double and 3 single gates. Including fastening for gates, stone posts not more than 4½ ft. between centers, set and dressed, stone posts for braces, and stones for cornere and gate posts. JOHN WHITELAW, Superintendent and Engineer, Water-Works Department, Cleveland, O. July 6.

Sewers.—WALTER P. RICE, City Engineer, Cleveland, O. July 7.

Water Works Supplies.—Stop-cocks, hydrants, wooden hydrant boxes and cast-iron stop-cock boxes; also laying water mains. JOHN NEWTON, Commissioner of Public Works, 31 Chambers street, New York City. July 7.

Sewer Repairing.—JOHN NEWTON, (*as above*). July 7.

Coal.—JOHN NEWTON, (*as above*). July 7.

Bridge.—High or low truss, steel or iron, 100 ft. long, 97 ft. clear span, 14 ft. roadway, 100 pounds capacity per sq. ft. Across Beaver creek. O. F. SERVISS, County Auditor, Springfield, Clark county, O. July 18.

Brick Tower and Iron Tank.—Brick tower 70 ft. above ground, 25 ft. diameter; wrought-iron tank 30 ft. high and 25 ft. diameter. Plans and specifications at the office of the water-works committee. A. F. PREVATT, Chairman, Committee on Water-Works, Thomasville, Ga. July 18.

Stone.—Broken trap rock, ¾-in., 200 cu. yds.; trap rock screenings, 200 cu. yds. Lieut. Col. HENRY C. HODGES, Dep. Q. M. G., U. S. A., U. S. Engineer Office, corner Houston and Greene streets, New York City. July 18.

Dredging.—In Maurice river, N. J. WM. F. SMITH, U. S. Agent, Wilmington, Del. July 21.

County Hospital.—Plans and specifications at the office of the County Commissioner. C. P. NEEDHAM, County Clerk, Omaha, Neb. July 22.

Bridge.—Two spans of 110 ft. at North Manchester, Wabash county, Ind. August 1. For particulars address FRANK KNIGHT, Wabash, Ind.

Contracting.

Furnishing Dredge, Etc.—The only proposal for furnishing a dredge, tug and two dump scows at the St. Mary's river, Mich., opened June 17 by Lieut. Col. O. M. POE, U. S. Engineer Office, Detroit, Mich. was from Carkin, Stickney & Cram, East Saginaw, Mich., at $11 per hour.

Bulkhead.—The following proposals were received by W. S. BARBOUR, City Engineer, Cambridge, Mass.: John P. Perkins & Son, $2.94 per ft.; John T. Scully, $3,136; J. H. Hayes & Co., $3,85. Awarded to J. P. Perkins & Son. No bids were received for the seawall, and this part of the work has been readvertised.

Red River Valley Ry.—Three proposals have been received by the Manitoba Government for the construction of this line from Winnipeg to the boundary at West Lynn, opposite Pembina, Dak., a distance of 75 miles. Hugh Ryan, $780,000; Mann & Holt, $840,000; Foley Bros., St. Cloud, Minn. (associated with Duncan McArthur, of Winnipeg), $850,000.

Paving.—At Leavenworth, Kan., contracts have been let at the following prices: round cedar block pavement on 6-in. concrete foundation, $1.87½ and $1.89 per sq. yd.; 5 x 24 ins. Colorado sandstone curbing, 85 cts. per ft.: Berea sandstone curbing, 5 x 24-ins., 82 cts. per ft.; 4 x 20-ins., 59½ cts. per ft. In July there will be let 75,000 sq. yds. of cedar pavement and 20,000 lin. ft. of curbing. GEO. T. NELLES, City Engineer.

Water Pipe.—The following proposals were received June 17 by the Executive Board, Rochester, N. Y., for cast-iron pipe and specials: Jackson & Woodin Manufacturing Co., Berwick, Pa.; 22 tons of 10-in. pipe at $31.90 per ton; 30 tons of 8-in., $31.90; 121 tons of 6-in., $32.90; 27 tons of 4-in., $34.70; 10,000 pounds of specials, .0275 cts. per pound; total for pipe, $6,576.60, specials, $275. Sayre Pipe Foundry Co., Sayre, Pa., $30.50 for 10, 8 and 6-in., $33 for 4-in., specials, .0245 cts.; totals, $6,187.50, $245. Warren Foundry & Machine Co., New York, pipe $34.20 per ton, total, $6,840; no bid for specials. M. J. Drummond, New York, $34 for 10, 8 and 6-in. pipe, $35.50 for 4-in., total, $6,840.50; no bid for specials. Buffalo Pipe Works, Buffalo, N. Y., pipe, $35 per ton; specials, 3 cts.; totals: $7,000, $300. Builders' Iron Foundry, Providence, R. I., specials only. The contract was awarded to the Jackson & Woodin Manufacturing Co.

Water Supply.—The only proposal for supplying Hamilton, O., with water from tube filter wells was from the National Water Supply Co., Cincinnati, O., for $9,000 complete, in accordance with plans and specifications submitted.

Special Castings.—The proposals received by the Water Board, Detroit, Mich., were: Russell Wheel & Foundry Co., 2.3 cts. per pound; Dry Dock Engine Works, 2.4 cts. Contract let to the former.

Paving Blocks.—The only bid for the contract for 100,000 granite paving blocks for the Department of Parks, Boston, Mass., was from S. & R. J. Lombard, of Boston, at $42.50 per 1,000.

Rails.—The contract for the rails for the Observatory Hill electric railway at Allegheny, Pa., has been awarded to the Cambria Iron & Steel Co., Johnstown, Pa.

Light Station.—The following were the bids (totals) for tower, buildings, etc., for Pipe Island light station, Michigan, opened June 13 by Major S. M. MANSFIELD, U. S. Lighthouse Engineer, Detroit, Mich.: J. L Learing, Detroit, $7,546.62; C. Sundberg & Co., Chicago, $8,450.

Reservoir.—The city of Providence, R. I., contemplates building a high service reservoir with a capacity of about 25,000,000 galls. Plans and specifications are expected to be ready, at the office of the City Engineer, in the course of about two weeks.

Dredging.—The following proposals for dredging in Staten Island sound were opened June 14. by Lieut. JOHN MILLIS, Tompkinsville, N. Y.: Atlantic Dredging Co., Brooklyn, N. Y., 22 cts. per cu. yd.; Morris & Cummings Dredging Co., New York City, 23 cts.; Henry DuBois & Sons, New York City, 26 cts.

The Volker & Felthousen Manufacturing Co., of Buffalo, N. Y., has purchased 32 acres of land at North Buffalo, on which to erect a large factory, making a specialty of high duty pumps for water-works in addition to the present line of pumps. The factory will have a frontage of 1,800 ft. on the Belt Line R. R. The remainder of the land will be used for workmen's dwellings; 200 hands will be employed.

T. Wm. Harris & Co., New York, are building the Union Passenger Ry., at Richmond, Va., which will be the longest electric road in the States. It will be 12 miles long, and will be operated on the Sprague system. The line will be opened in the fall. The firm has recently completed a street railroad at Cincinnati, O., and a reservoir for the government at Coaster's Harbor, Newport, R. I., and is now engaged on a reservoir at Woodstock, Vt.

Dike.—The following proposals for extending the dike in the harbor at New Haven, Conn., were opened June 16 by Lieut. Col. D. C. HOUSTON, U. S. Engineer Office, New York City: Owen J. Conley, Guilford, Conn., $1.03 per ton, $5,150; James Roddin, Branford, Conn., $1.21, $6,050; Chas. H. Edwards, Boston, Mass., $1.27½, $6,375; John A. Bouker, New York City, $1.37, $6,850; John Beattie, New Haven, Conn., $1.37, $6,850.

Trestling.—Proposals were received June 15, by J. F. HINCKLEY, Chief Engineer, St. Louis, Arkansas & Texas Ry., for pile and frame trestles on the Fort Worth extension. The bidders were; Britton, Lyon & Grimes, H. H. Harding, C. C. Herrenkind, J. W. Asseltine, Geo. Dougherty, McCully Stone Mason Co., Kearns Bros. & Noble, and H. S. Hopkins Bridge Co. The contract was awarded to Britton, Lyon & Grimes.

Pier.—The following proposals for a pier, 90 ft. long, of stone filled cribs, at West Sister Island light station, Lake Erie, O., were opened June 13 by Major S. M. MANSFIELD, U. S. Lighthouse Engineer, Detroit, Mich.: David Fleming, Detroit, white pine timber, $37; white pine plank, $30; screw bolts, 4 cts. per pound; drift bolts, 3 cts. per pound; spikes, 4 cts. per pound; snubbing posts, $7 per post in place; stone, $6 per cord; total, $1,851.68. Prices on a blank bid were; $37, $35, 5 cts., 4 cts., 3 cts., $6, $4, $1,782.60.

Pumping Engine.—The following proposals were received by the Water Department, Camden, N. J., for a pumping engine with a daily capacity of 10,000,000 galls., raised to a height of 130 ft.: Geo. F. Blake Manufacturing Co., New York; $32,400, $35,500, $45,500. Henry R. Worthington, New York; $19,275, $39,500. Davidson Steam Pump Co., New York, $28,000, $39,500. Holly Manufacturing Co., Lockport, N. Y.; $29,500, $39,500. Dixon Manufacturing Co., $67,500. The contract was awarded to the Geo. F. Blake Manufacturing Co., for $35,500.

Sewers and Stone.—At Montreal, Canada, contracts have been awarded as follows: Sewers; L. McDonald, $10.17 per cu. yd., $10, $7.74, $8.60, $10.40, $9.34; John Parker, $9.50, $9.79, $9.73. Trefle Bastren, $9.75. R. Chartrand, $13, $11.80. N. Laporte, $11.10. Robt. Parker, $7.50. T. Bracken, $10.25. John Murray, $11.75. D. Bissette, $9.88, $9.92, $11.08.—Stone curbing; A. Desermeault, straight and curved, 53 and 60 cts. per ft.—D. Lawrence: sidewalk flagging, 4 ft. by 2 ft. and 6 ft. by 3 ft., $2.20 and $2.85: crossing flags 20 and 24 ins. wide, 50 and 55 cts.

Drilling Well.—The contract for drilling a gas well at Ashtabula, O., has been awarded to W. C. Manning, of Franklin, Pa., at the following prices: 1,000 ft., $1.50 per ft.; 1,500 ft., $1.25; 2,000 ft., $1.10; 2,500 ft., $1; 3,000 ft., 95 cts. The contractor is to furnish the derrick and all machinery, and to have 50 cts. per ft. extra for reaming below fresh water level to case off salt water; the village will furnish all casing.

Water-Works.—The Palmer Lake Water & Electric Light Co., has awarded the contract for a complete system of water-works for Palmer Lake and Glen Park, Col., to the Michigan Pipe Co., Bay City, Mich. Work to be commenced at once.—The Michigan Pipe Co. will also put in water-works at Berthoud, Col.—Inman & Co., of New York, have the contract from the Decatur Land, Improvement & Furnace Co., for a system of water-works at Decatur, Ala., to cost $200,000. The water will be taken from the Tennessee river and pumped to a stand-pipe 150 ft. high.—Louis Metesser, New Orleans, will build the works at Greenville, Miss.

Granite.—The following proposals for James River granite for the new City Hall were opened June 13 by W. E. CUTSHAW, City Engineer, Richmond, Va.: Westham Granite Co., 65, 80, 90, 59 and 59 cts. per cu. ft. for Classes 1 to 5; ashlar, 49 cts. Richmond Granite Co., 65, 75, 72, 65, 60 cts. for Classes 1 to 5; bid on Class 3 as follows: up to 20 cu. ft., 72 cts. per ft.; 20 to 30, 78 cts.; 30 to 40, $1.05; 40 to 50, $1.30; over 50, add 4 cts. per ft. J. B. Mitchell & Co., 68, 70, 65, 72 and 70 cts. for Classes 1 to 5; bid on Class 5 as follows: up to 20 cu. ft., 70 cts. per ft.; 20 to 30, 80 cts.; 30 to 40, $1; 40 to 50, $1.25; over 50 cu. ft., add 5 cts. per ft. Contract awarded to the Westham Granite Co., of Virginia.

Bridge.—The following proposals for two highway bridges at Almonte, Ont., Canada, were received recently: *Masonry*; upper bridge to have 2 abutments and 2 piers, 347 cu. yds.; lower bridge, 2 piers and 1 abutment, 184 cu. yds.; total masonry 531 cu. yds.: Geo. Bradford, $6,480; John McKechmie, $6,523; Jos. Boucher, $6,785. Contract awarded to Geo. Bradford.—*Iron Work*; upper bridge, 3 spans of 100 ft., 18 ft. roadway, 2 sidewalks 6 ft. wide; rolling load, 90 pounds per sq. ft.; lower bridge, 2 spans of 97½ ft., 18 ft. roadway, 1 sidewalk 6 ft. wide, same rolling load: Dominion Bridge Co., Lachine, Que.; $6,870, $4,075.50; total, $10,945.50. Trenton Bridge Works, Trenton, Ont., $7,050, $4,275; $11,325. Central Iron Works, Peterboro, Ont.; $7,300, $4,200; $11,500. Contract awarded to the Dominion Bridge Co. ANDREW BELL is the engineer.

Street Improvement.—The following proposals were read before the Borough Council, South Bethlehem, Pa., on June 15: M. Lannan, South Bethlehem, Macadam system, $1.84; Telford system, $2.52 per ft. Bryan O'Neill, Allentown, Pa., $3.50, $3.50; A. J. Howell, New York, $4.13, $3.88; Jas. Crilly & Sons, Allentown, $4.39, $4.48 (a representative of the firm, present at the meeting, stated that each of these prices should have been $1 less). P. C. McGee, South Bethlehem, $4.85, $4.50. A. J. Howell excepted rock excavation in his bid and proposed to do other work not called for in the specification, estimate based on $10,000 expenditure. He also suggested alterations in the plan of construction. Action was deferred, but the contract will probably be awarded to A. J. Howell. It is expected that about $12,000 will be appropriated for street improvement this year, but that not more than $6,000 will be expended. ADAM BRINKER is Chairman of the Street Committee.

City Work.—At Helena, Mont., a contract for grading has been awarded to C. W. Wilson; solid rock, $1 per cu. yd., loose rock, 59 cts., earth, 33 cts.—At Lincoln, Neb., a contract for cedar block paving has been awarded to H. C. Clarke.—At Brooklyn, N. Y., the following proposals have been received for flagging sidewalks: Thos. R. McCann, 19¼ cts. per sq. ft.; C. S. Lynan, 20 cts.; for fencing lots C. S. Lynan, $1 per ft.—At Little Falls, N. Y., contracts for sewers have been awarded to Michael Davin at $1.23, $1.95, 54 cts. and 50 cts per ft.—At Milwaukee, Wis., the following sewer contracts have been let: John Donahue, $1.30, $1.40 per ft.; C. Roediger, $1.40, $1.55, $1.65 and $3.50 per ft.; J. C. F. Brand, 95 cts., $1.05, $1.30 and $1.63 per ft.: J. Reynolds, $1.58, $1.83 and $4.02 per ft.; J. Werner, $1.20 and $1.35 per ft.—At Little Rock, Ark., a grading contract has been awarded to E. Weigel & Co. at 19 cts. per cu. yd.—At Toronto, Canada, the following contracts have been awarded: Wm. Cathro, cedar paving, 81 and 84 cts. per sq. yd., curbing, 22 and 22½ cts. per ft.; crossing plates, $3 per 100 lbs. E. & C. Farquhar, 99 cts., 24 cts., $3. David Chalmers, stone flagging, $4.15 and $5.50 per lin. ft.; iron girders, $1 each. George Farquhar, stone flagging, $4.94 per sq. ft., iron girders, $1 each.—At Detroit, Michigan, a contract for paving has been awarded to S. R. Thompson at $9,838.16. The lowest bids on the different sections of lateral sewers were: T. G. Whittaker, 78 cts. per lin. ft.; F. Porath, 67 and 68 cts.; John Wagner, 98 cts.; Frings & Koenig, 79 cts.—At Cleveland, O., the lowest bid for paving was from Rieley & Brennan, $18,251.80, and for sewer, Campbell Bros., $17,278.60.

Sewers and Grading.—At Kansas City, Mo., the following contracts have been awarded: F. T. Mullholland, brick sewers, 2.6 ft., $1.90 cts.; 2.3 ft., $2.35; 24-in., $2.20 and $2.65; 40 in., $3.85; 32-in., $3.15; 18-in. pipe, $1.26; manholes, $17; catch basins, $67; rock excavation, $3.15 per cu. yd.; concrete, $4 per cu. yd.; lumber, $20 per 1,000 ft. B. M.; rubble, $5.75. Total, $8,848.67. T. F. Ryan, grading, 21¼ and 43 cts. per cu. yd.; 18-in. pipe, 90 cts. per ft. M. J. Payne, grading, 25 cts. per cu. yd. N. T. Hall, grading, 24¾ cts. per cu. yd.

Street Work.—The following proposals were opened June 16 at the Department of Public Works, Brooklyn, N. Y.: Hancock street; Thomas Newman; pavement, $3.70 per sq. yd.; improvement, 20 cts. per lin ft.; new curb, 66 cts. per lin. ft.; new bridge stone, 48 cts. per sq. ft. Charles Guidet, $2.65, 9 cts., 65 cts., 63 cts. Harris & Maguire, pavement, $2.52; improvement, 45 cts. Henry Mock, $2.49, 35 cts., 75 cts., 50 cts. Daniel Gallagher $2.27, 2 cts., 65 cts., 45 cts. Robert Furey, $2.23, 50 cts., 77 cts., 64 cts. Thomas Monahan, $2.19, 25 cts., 60 cts., 65 cts. Charles Hart, $2.19, 9 cts., 59 cts., 40 cts.

Dock Work.—At the Department of Docks, New York City, on June 16, the contract for work at W. 132d street, North river, was awarded to O'Connell & Coffey; dredging, 38 cts. per cu. yd.; new crib bulkhead $10,875; repairs to existing crib, $2,175; new wooden pier $15,583; total, $31,573. The other bidders were John Gillies, $33,328; John M. Monks, $33,367; Joseph Walsh, $35,858; John W. Flaherty, $37,390——The proposals for the crib bulkhead at E. 76th street were: O'Connel & Coffey, $4,945; John W. Flaherty, $5,300; Joseph Walsh, $6,000. They were all rejected and the work is re-advertised; proposals will be received until July 1.——The following proposals were received June 21, for a new wooden pier at the foot of W. 31st street, North river: Joseph Walsh $48,000; P. Sanford & Ross, $50,750; James D. Leary, $52,240; John Gillies, $56,388. Contract awarded to Joseph Walsh.

Stone Sidewalk.—The following proposals have been received by the Trustees of the Asylum for the Insane, Toledo, O.: Albert Nenkem, Toledo, 19 cts. per sq. ft.; Maxwell Stone Co., Toledo, 19¾ cts.

Tar and Asphalt Pavement.—The only proposal received by Col. JOHN M. WILSON, Office of Public Buildings and Grounds, Washington, D. C., for laying coal tar distillate and asphalt pavement in the Smithsonian grounds, was from H. L. Cranford, Washington, $2 per sq. yd.

Georgia Southern & Florida R. R.—Proposals for the construction of this road were received by the Macon Construction Co., of Macon, Ga., the contractors, from a number of firms. Mr. J. LANE, General Manager of the construction company, says that the company feels flattered by having so many bids, and from firms of such ability, and that railroad men of the south pronounce it quite extraordinary. For the entire work there were thirteen bids, and for parts of the work or for particular kinds of work on the entire line, 30 bids. The contract for grading was awarded to T. J. James & Co., of Atlanta, Ga., and the contract for ties and trestles to Pittman, Baker & Co., Thomasville, Ga. W. B. SPARKS, is President of the construction company, and H. L. JEWETT, Secretary and Treasurer.

Street Improvement.—Proposals were received recently by the Board of Public Works, Jersey City, N. J., from John Wilson, Thomas Cogan, Samuel Overton, Henry H. Holmes, William Omsby, Michael Curley, Thomas Cavanagh and Thos. H. O'Neill. The prices ranged as follows: earth excavation, 18 to 30 cts. per cu. yd.; rock excavation, $1 to $5; earth filling, 1 to 15 cts.; sand or gravel filling, 75 cts. to $1.85; paving, $1.05 to $1.50 per sq. yd.; curb stone, 49 to 65 cts. per lin. ft.; bridge stone, 5 to 75 cts. per sq. ft.; flagging, 13 to 20 cts. per sq. ft.; repaving, 10 to 35 cts. per sq. yd.; resetting curbing, 1 to 6 cts, per. lin. ft.; relaying bridge stone, 1 to 8 cts. per sq. ft.; relaying flagging, 1 to 7 cts. per sq. ft.; resetting receiving basins, $2 to $20; bringing manholes to grade, $1 to $2; rebuilding receiving basins, 50 cts. to $85, cribbing, 5 to 40 cts. per lin. ft.; new receiving basins, $6 to $120.

The Westinghouse Machine Co., Pittsburg, Pa., has shipped engines as follows within 30 days to electric light companies at the following places: Easton, Md., 60-H.P.; Alliance Gas Light Co., Alliance, O., 45-H.P.; Sheffield, Ala., 75-H.P.; Electric Development Co., San Francisco, Cal., 35-H.P.; Queen City Electric Co., Gadsden, Ala., 45-H.P.; Washington, Kan., 60-H.P.; Parkersburg, W. Va., two 60-H.P.; Hartford, Conn., two 60-H. P.; Hot Springs, Ark., two 60-H.P.; Pittsfield, Mass., second order, 60-H.P.; Olney, Ill., second order, 60-H.P.; Plainfield, N. J., third order, 150-H.P.; New England Weston Electric Light Co., third order, 25-H.P. The company averages shipments of nearly 60 engines per month, the average size being about 45-H.P. It has suffered considerably from lack of foundry capacity since the recent fire, but the new foundry, which is nearly completed, will enable it to turn out at least 100 engines per month.

Pipe and Specials.—The following proposals for water pipe and specials were opened June 14 by LOUIS LESAGE, Superintendent of Water Works, Montreal; the quantities were, 615 tons of 24-in., 100 tons of 6-in., 50 tons of 4-in. and 15 tons of specials: Geo. Dibley & Son, Montreal, $35.50, $35.75, $36, $54. Cox & Greene, Montreal, $35.49, $36.70, $37.32, $56. Clay Cross & Co. $37.44, $38, $39.36, $52.80. Gartshore, Hamilton, Ont., $35.84, $35.84, $36.96, $61.60. I. & H. Taylor, Montreal, $33.55, no bid, $35.38, $57.27. All sizes of pipe: B. N. C. Connal (representing T. Eddington & Son, Glasgow), pipe, $32.94 per ton; specials, $61.70 per ton. T. T. Turnbul, Montreal, $36.48, $57.45. Heidimand & Son, Montreal, $33.80, $63.30. Middleton & Merideth, Montreal, $35.24, $56. Bellhouse, Dillon & Co., Montreal $35.44, $51. Builders' Iron Foundry, Providence, R. I., lump sum for specials, $650.

Bridge.—The following proposals have been received by the County Commissioners of Lancaster and Chester counties, Pa., for the bridge over the Octoraro creek: Pittsburg Bridge Co., Pittsburg, Pa., $1,394 according to specifications, $1,344 on their own plan. J. P. Bartley, Bartley, N. J., own plan, $1,869.50. S. Stauffer, York, Pa., $1,283. Groton Bridge & Manufacturing Co., Groton, N. Y., low or high truss, $1,285. Standard Bridge Co., Philadelphia, Pa., $1,400. J. Denithorne & Son, Phœnixville, Pa., $1,648. E. McMellon, iron bridge, $2,350; wooden bridge, $1,877. Wrought-Iron Bridge Co., Canton, O., own plan, $19.75 per lin. ft. Mount Vernon Bridge Co., Canton, O., $22 per ft. Champion Bridge Co., Canton, O., own plan, $23 per ft. The contract was awarded to the Pittsburg Bridge Co. for $1,394. The contract for masonry was awarded to Joseph Kreckel, of Lancaster, Pa., for $643.

Bridge Contracts.—Kennedy & Morris have the contract for the Chickasaw bayou bridge at Vicksburg, Miss., for $425.——The Groton Iron Bridge Co., Groton, N. Y., has the contract for a bridge at Rochester, N. Y., for $28,000.——John Denithorn & Son, Phœnixville, Pa., have the contracts from the County Commissioners, Norristown, Pa., for bridges across the Perkiomen river and Swamp creek at $19.28 and $17.33 per ft. respectively.— The Pittsburg Bridge Co., Pittsburg, Pa., has the contract for an iron bridge across the South river at Waynesboro, Ind., for $2,100.——R. Jackson, Denver, Col., has the contract for three small wooden bridges. ——The Columbus Bridge Co., Columbus, O., has the contract for the iron bridge, 200 ft. span, across the Scioto river at Columbus, for $21,000.——The Phœnix Iron Co. has the contract for the iron work of the Arthur Kill bridge, and Alexander McGaw, of Philadelphia, has the contract for the masonry.——The Jewell Granite Co., Lincoln, Me., has the contract for the stone for the bridge for the Canadian Pacific Ry, at Mattawamkeag, Me.

Railroads.

Grading and Tracklaying.—*East of Chicago.*—Montreal, Valleyfield & Beauharnois Ry. Ground has been broken on this new Canadian line. JAS. WRIGHT is the contractor.——Toledo, St. Louis & Kansas City R. R. The change to standard gauge will be made on Sunday, June 26.——Evansville & Richmond R. R. Grading is to begin next month on this line which is in the interest of the Evansville & Indianapolis Company.

Southern.—West Virginia R. R. Grading is progressing on this line which is to run from the Pennsylvania State line at the Monongahela river to Newburgh, W. Va., on the main line of the Baltimore & Ohio, a distance of 40 miles. The line is located through the center of an excellent field of coking coal which it is proposed to develop. JONATHAN BARRETT is Chief Engineer.——Nashville & Knoxville R. R. Ground has been broken on this line at Watertown, Tenn., and construction will be pushed at all points from Nashville east to a connection with the Cincinnati Southern. A branch is also to be built from Carthage to Gordonsville. C. A. GATCHELL is the contractor and Maj. A. G. NEGLEY is Chief Engineer.——Gulf & Ship Island Ry. Tracklaying has begun on the southern portion of this line.——Mobile & Dauphin Island Ry. This line, whose importance has been noticed in these columns, is being rapidly constructed and the dredging, dock building, and construction of storehouses on Dauphin Island is also under contract. The officers are ROBERT SEWELL, President; HENRY E. FANSHAW, Vice President; GEORGE LEIGHTON, Chief Engineer.——Kansas City, Memphis & Birmingham R. R. Fifty miles of track have been laid on the Birmingham extension and the tracklaying and bridge building is in progress on the remainder of the line. Work is also in progress on the line from Birmingham to Bessemer and the branch to Aberdeen.——Carolina, Knoxville & Western R. R. Co. The contract for building this line has been let to the Georgia Construction Co. The line is to run from Knoxville, Tenn., to Greenville, S. C., and thence under the name of the Atlantic, Greenville & Western R. R., it extends to Augusta, Ga. On this latter division the grading is nearly completed.

The Northwest.—Duluth, Watertown & Pacific Ry. Grading is reported in progress on this line at Watertown, Dak.——Chicago, Milwaukee & St. Paul Ry. A branch nine miles in length is under contract to Hotel St. Louis on the shore of Lake Minnetonka.

The Southwest.—Pine Bluff, Monroe & New Orleans Ry. Track laying is in progress on the extension of this Arkansas road. C. M. NEEL is President, and J. J. MARTIN, Chief Engineer.——Jeanerette, Abbeville, & Western Ry. Grading is completed on about six miles of this Louisiana line and it is hoped to complete the 30 miles now located by October. F. M. WELCH of Jeanerette is President.——Current River R. R. On this branch of the Kansas City, Fort Scott & Gulf R. R., from Willow Springs to the Mississippi river opposite Cairo, 81 miles are now under contract.——Kansas City & Southwestern R. R. This line in the Missouri Pacific interest which was built last year from Paola north to within seven miles of Kansas City when work was stopped on account of legal difficulties, is to be taken up and pushed to completion at once. A. M. MCCRACKEN is the contractor.——San Antonio & Aransas Pass Ry. On the Houston extension the track has reached Wallis on the Gulf, Colorado & Santa Fè Ry.

Rocky Mountain and Pacific.—Pueblo & State Line R. R. This line, the Colorado extension of the Missouri Pacific, is being graded by the Fitzgerald & Mallory Construction Co. The line runs from Pueblo eastward between the Atchison, Topeka, & Santa Fe line and the Arkansas river, a distance of 26 miles; near Nepesta it crosses the A. T. & S. F. and runs northeast to Ness City, Kan. H. R. HOLBROOK is Chief Engineer.

Surveys.—*East of Chicago.*—Louisville, Evansville & St. Louis Air Line R. R. It is stated that the directors have voted to construct the Huntingburgh, Tell City & Cannelton branch line, for which a preliminary survey was made last April.——Castine & Bangor R. R. The preliminary survey of this Maine line has begun.——Upper Coos R. R. The franchise for this New Hampshire line has been purchased by FRANK JONES and others and the survey will be completed at once from Groveton Junction to the Canada line. It is stated that E. G. SWEET of Woonsocket, R. I., has the contract for building the line. A charter has also been secured in Canada and the line will be extended north to a connection with the International Ry.

Southern.—Warrior Coal Fields R. R. Co. J. N. GALLUP, the Chief Engineer, has completed the preliminary survey of this line from Meridian, Miss., to Narkeeta. From this point to Gainesville, Ala., an old line partially graded is now being finished ready for tracklaying, and with the completion of the locating survey, which is now in progress, the line from Meridian to Narkeeta will be put under contract.——Mobile & Ohio R. R. The company has sent out four different parties of engineers to make preliminary surveys for the line from Corinth, Miss., to Birmingham.——Illinois Central R. R. Preliminary lines are being run for an extension from Aberdeen, Miss., northwest *via* Okalona. The people of Chattanooga, Tenn., are excited over a rumor, which has probably little foundation in fact, that the Illinois Central is to build to that point from Aberdeen. ——Tennessee Central & Alabama R. R. This line, which is to run from Tenton, Tenn., to Florence, Ala., is reported under survey. Col. HORACE SCOTT, of Louisville, is President.——Tennessee Midland R. R. It is stated that the line between Memphis and the Tennessee river, a distance of 135 miles, is to be placed under contract at once. The locating survey is now in progress from Knoxville to the Cincinnati Southern.

The Northwest.—Winona & Southwestern Ry. Co. Officers of this Minnesota company have been elected as follows: President, WM. MITCHELL; Vice President, E. S. YOUMANS; Secretary, THOMAS SIMPSON. The line is to be placed under survey at once.——Illinois Central R. R. The preliminary survey of the Freeport, Dodgeville & Northern line is completed and much of the right of way is secured. The company has voted to increase its capital stock $10,000,000, the amount to be applied to the purchase of the stock of the Iowa Falls & Sioux City and Dubuque & Sioux City lines, and for completing the Chicago, Madison & Northern line.—— Wisconsin Midland Ry. A preliminary line has been surveyed for this road from Fond Du Lac, Wis., to Florence, 150 miles. The line runs about midway between the Milwaukee, Lake Shore & Western and Milwaukee & Northern roads. Surveyors are also working on a branch from Kaukauna east to Sturgeon Bay *via* Green Bay. The company has filed articles of incorporation in Michigan and proposes eventually to build north to L'Anse. DANA C. LAMB of Fond Du Lac is Secretary.——Minnesota & Northwestern R. R. It is rumored that right of way is being secured for a line between Minneapolis and St. Paul.

The Southwest.—Atchison, Topeka & Santa Fé R. R. There seems to be little doubt that the company intends soon to build to St. Joseph both from Atchison and from Carrolton, Mo.

Rocky Mountain and Pacific.—Vancouver, Klickitat & Yakima R. R. R. A. HABERSHAM is in charge of the preliminary surveys for this line which is to run from Vancouver, W. T., to the coal fields at the head waters of the Lewis river.——Santa Rosa, Sebastopol & Green Valley R. R. The locating survey is completed of this California line, and the right of way has been secured.

(*Continued on page XIV.*)

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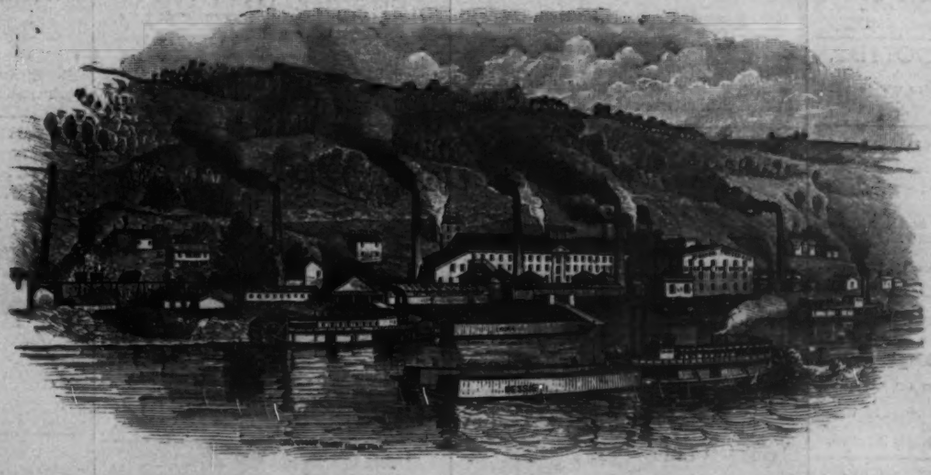

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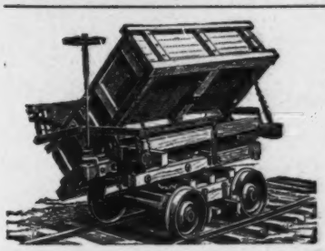

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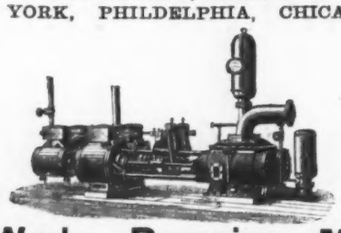

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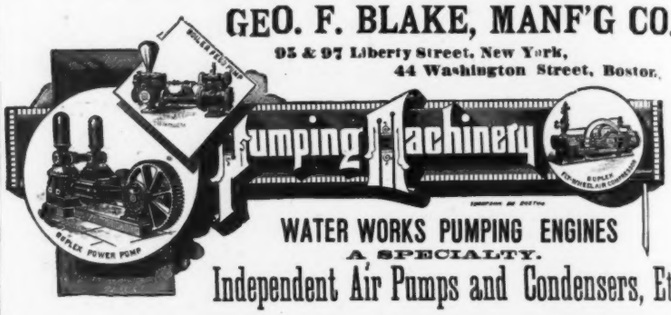

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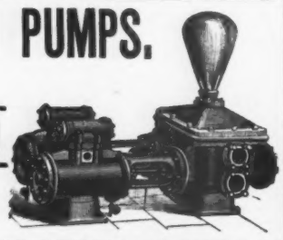

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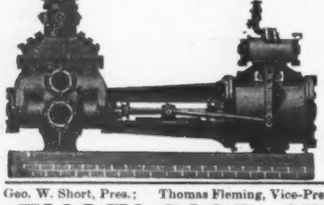

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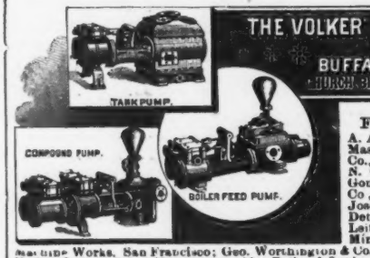

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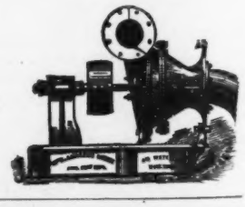

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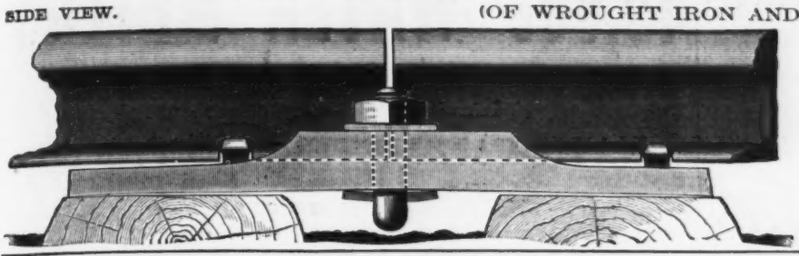

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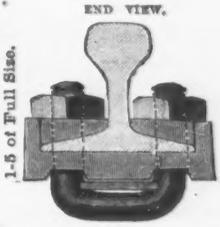

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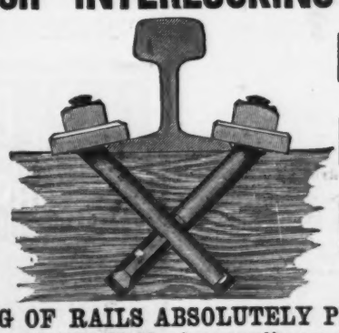

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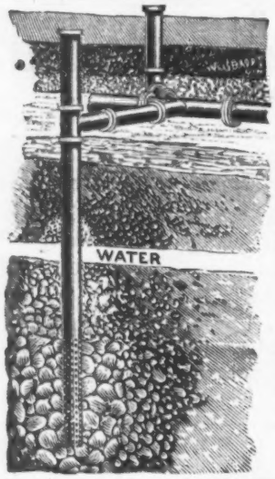

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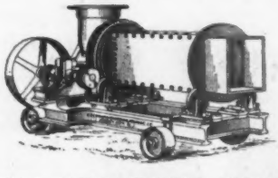

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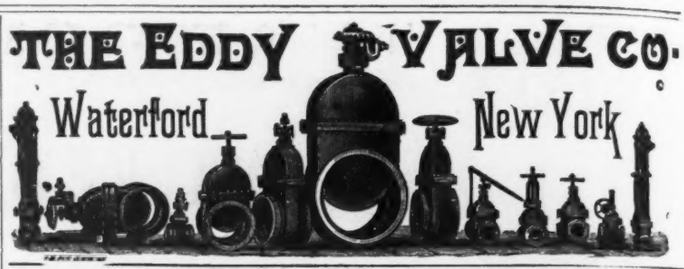

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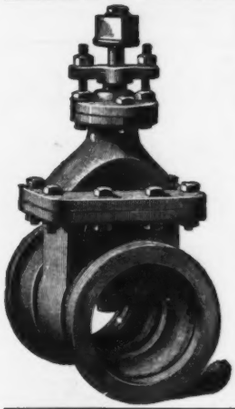

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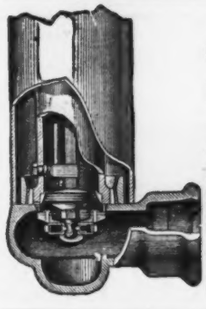

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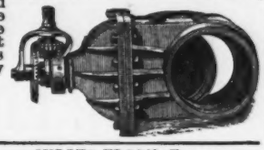

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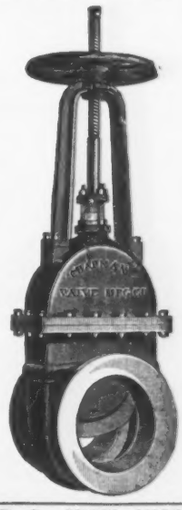

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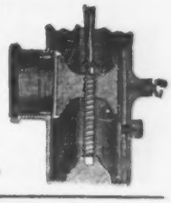

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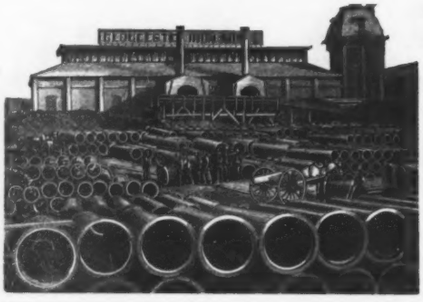

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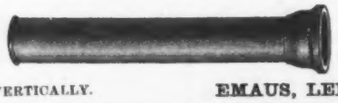
WATER  AND GAS.

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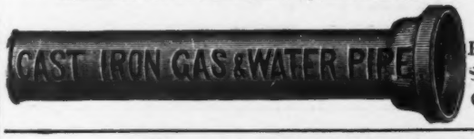

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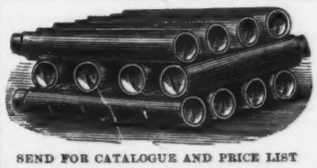

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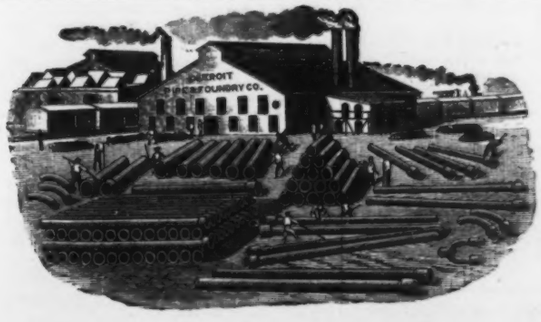

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Removal of a Wreck in Rappahannock River, Va.

U. S. ENGINEER OFFICE, No. 810 19th St., N. W.
WASHINGTON D. C., May 5, 1887.

SEALED PROPOSALS, in triplicate, for the removal of a wreck in Rappahannock River Va., will be received at this office until noon, on the 6th day of June, 1887, and opened immediately thereafter.

The hull, ribs, keel, and all remaining portions of the two masted schooner Spray, lying in about 11 feet of water, about 6 8-10 miles below Fredericksburg, are to be entirely removed.

Specifications, containing detailed information and blank forms of proposals can be obtained at this office, where charts can also be seen.

The right to reject any or all proposals is reserved. S. T. ABERT, U. S. Agent. 20-3t

Proposals for Dredging and Rock Excavation in Rappahannock River, Va.

U. S. ENGINEER OFFICE, No. 810 19th St., N. W.
WASHINGTON, D. C., May 11, 1887.

SEALED PROPOSALS, in triplicate, for Dredging and Rock Excavation in Rappahannock River, Va., will be received at this office until noon, on the 11 day of June, 1887, and opened immediately thereafter.

Specifications, containing detailed information, and blank forms of proposals can be obtained at this office, where charts and plans can also be seen.

The right to reject any or all proposals is reserved. S. T. ABERT, U. S Agent. 20-3t

Improving New York Harbor, N. Y.

ENGINEER OFFICE, U. S. ARMY,
Room 31, Army Building, cor. Houston and Green Sts., New York, May 3, 1887.

SEALED PROPOSALS for Dredging one million cubic yards, more or less, of material from the main ship channel in the vicinity of Flynn's Knoll, or from the Swash Channel, New York Harbor, will be received at this office un il twelve (12) o'clock, M., on Wednesday, May 18, 1887. Proposals must be made in triplicate, Specifications, blank forms and instructions to bidders may be had on application at this office.

WALTER McFARLAND,
20-1t Lieut. Col. of Engineers.

Proposals for Dredging and Embankment.

U. S. ENGINEER OFFICE, 2136 Pennsylvania Ave., N. W., Washington, D. C., May 7, 1887.

SEALED PROPOSALS for dredging and Embankment on Improvement of Potomac River, will be received at this office, until 12 M., on Saturday, May 28th 1887.

For specifications, forms of bids and other information, apply at this office.

PETER C. HAINS,
Lieut.-Col. of Engineers.

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Chi go, Ill. April 2., 1887.

SEALED PROPOSALS, in dup ic te, will be received at this office until 12 o'clock noon, st ndard time, May 20, 1887, for furnishing and delivering the iron and steel necessary for the lock gates and filling valves at La-Grange Lock, Illinois River.

Approximate amount required.
Steel 43,000 lbs
Wrought-iron 17 500 lbs.
Cast-iron 110,000 lbs.

For specifications, blanks for proposals and all information, apply at this office.

THOS. H. HANDBURY,
17-4t Major Corps of Engineers, U. S. Army.

Dredging in Thames River, Conn.

ENGINEER OFFICE U. S. ARMY,
Room 57, Army Building, cor Houston & Greene Sts., NEW YORK, May 7, 1887.

SEALED PROPOSALS, in triplicate, for dredging in the Thames River, Conn., will be received at this office until 12 o'clock M. on Monday, June 6, 1887. Further information, specifications and forms of proposals can be obtained at this office.

D. C. HOUSTON,
19-4t Lieut. Col. of Engineers.

BRIDGES.

SEALED PROPOSALS will be received at the Auditor's office in Franklin county, Ohio until **Tuesday, May 19, 1887, at noon** for the construction of sandstone masonry approaches, road embankment and superstructure of wood or iron for bridges to be built over the Scioto river and Columbus feeder on the line of the Clickinger road in Hamilton and Jackson townships, Franklin county, Ohio.

River span will be 200 ft. in the clear, canal feeder span will be from 30 to 40 ft. in the clear.

The County Commissioners will receive and consider proposals for iron substructure for the Columbus feeder bridge.

All work to be done in accordance with plans and specifications on file in the Auditor's office, Franklin county, Ohio.

The Commissioners reserve the right to reject any or all bids.

By order of the Commissioners of Franklin county, Ohio. FRANK J. REINHARD,
County Auditor.

Notice to Sewer Contractors.

SEALED PROPOSALS will be received by the Common Council of the city of Ft. Wayne Ind., until 8 o'clock P. M., the 24th day of May, 1887, for the construction of a double ring Brick sewer 6 feet diameter, and 3,500 feet in length. Proposals will be accompanied by a written guarantee that in case the bid should be accepted and the contract awarded, they will enter into contract with good and sufficient security within 10 days after the notice of such acceptance. Plans and specifications can be seen at the office of the city Civil Engineer, where any information in regard to the work can be had.

The council reserves the right to reject any and all bids.

By order of the Common Council of the city of FT. WAYNE, INDIANA.

19-3t J. S. GOSHORN, City Civil Engineer.

THE PENNSYLVANIA RAILROAD COMPANY,
Office, 233 South Fourth Street,
PHILADELPHIA, May 11, 1887

SEALED PROPOSALS, addressed to the undersigned (and marked on the outside "Proposals"), will be received at this Office until 9 A. M., May 24, 1887, for furnishing all labor and materials and erecting, complete, Little Juniata Bridge, No. 10, Middle Div. P. R. R., to consist of a double track, three span ribbed arch stone bridge, about 200 ft. long.

Proposals to state, (1.) Price per cu. yd. for Excavations. (2.) Price per cu. yd. for Masonry, including Skewbacks and Coping, and all Centering. Falseworks, Cofferdams, and other appliances. Plans and specifications can be seen at this office. This Company reserves the right to reject any or all proposals.

WM. H. BROWN,
20-1t Chief Engineer.

THE PENNSYLVANIA RAILROAD COMPANY,
Office, 233 South Fourth Street,
PHILADELPHIA, May 11, 1887.

SEALED PROPOSALS, addressed to the undersigned (and marked on the outside "Proposals"), will be received at this Office until 9 A. M., May 20, 1887, for furnishing all labor and materials, and erecting, complete, Little Conemaugh Bridge No. 3, Pittsburg Div. P. R. R., to consist of a double track, three span, ribbed arch, stone bridge about 250 ft. long.

Proposals to state. (1.) Price per cu. yd. for Excavations. (2.) Price per cu. yd. for Masonry, including Skewbacks and Coping, and all Centering, Falseworks, Cofferdams and other appliances. Plans and specifications can be seen at this office. This Company reserves the right to reject any or all proposals.

WM. H. BROWN,
20-1t Chief Engineer.

Amsterdam, N. Y., Sewers.

Notice to Contractors.

SEALED PROPOSALS will be received at the office of the sewer commissioners in the city of Amsterdam, N. Y, until 2 o'clock P. M. on the 25th day of May, 1887, for labor and materials for constructing sewers in districts numbered 2, 3, 4, 5 and 6 in said city, according to plans and specifications and conditions on file in the office of said sewer commissioners. Forms of proposals, estimates, contracts, bonds and copies of specifications and conditions may be obtained of the commissioners, or will be mailed on application to the secretary of commissioners.

All bids must be accompanied with a bond of $1,000, with two surities, that the bidder will accept and execute a written contract for the labor or materials in case it shall be awarded him. Such bond shall be acknowledged, and the sureties shall justify before some officer authorized to take acknowledgments, in double the penalty of the bond.

The commissioners reserve the right to reject any or all bids.

H. B. WALDRON,
Secretary of Commission.
WM. B. LANDRETH, Constructing Eng. 20-2t

Notice to Railroad Contractors.

50 Miles of Railroad Grading work to be let at private contract, on the Aspen Extension of the Denver & Rio Grande Railroad, running down the Roaring Fork River to Glenwood Springs. Wood, water and grass. Free transportation for grading outfits from any point on the D & R. G. R. h.

Profiles and specifications to be seen at our office, 1653 Wazee St., Denver, Colo.

McMURTRIE & STREETER.
Contractors.

Sewers and Appurtenances.

Corning, N. Y.

SEALED PROPOSALS for the construction of the above, will be received by the Sewerage Commission of Corning, N. Y., until 2 P. M. Tuesday, May 17, 1887. A certified check for $1,000, drawn to the order of the Commission, must accompany each bid. The work contemplates approximately 13 miles of sewers, with basins, manhole and flushtanks. Proposals will be received for the materials and work complete, and also for the work, if materials are furnished by the Commission. Work to be completed by Dec. 1, 1887. Further information may be obtained of the secretary of the commission or the engineer in charge. Plans and specifications may be seen after April 28 at office of Corning Gas Co., Corning, N. Y., or at office of engineer corner Broad and Market Sts., Newark, N. J.

C. PH. BASSETT, Eng. in Charge. H. P. SINCLAIR. Secy. of Com.
17—4t

Timber Dry Docks.

BUREAU OF YARDS AND DOCKS,
NAVY DEPARTMENT,
WASHINGTON, April 19, 1887.

SEALED PROPOSALS will be received at this Bureau by the undersigned until 1 o'clock noon, on Wednesday the 29th day of June, 1887, at which time and place the proposals will be opened in the presence of bidders, for the construction, by contract, of two timber Dry Docks of the following general dimensions, with iron caissons or floating gates, pumps, boilers, engines, pump houses, capstans, bollards, discharge and drainage culverts, and all other attachments pertaining thereto, complete, said docks to be located at the New York and Norfolk Navy Yards, respectively, each dock to be not less than 480 feet in length from the inside of the coping stone at the head of the dock to the outer caisson abutment at the entrance, the width not less than 125 feet between the coping, from side to side, measured across the length of the dock midway from the ends; draft on sill not less than 25 feet 6 inches; width on floor not less than 40 feet, entrance 80 feet wide.

All patents or patented articles, if any, employed in the construction of these docks are to be included in the proposals.

That portion of the dock exposed to the water at all times to be of timber impregnated with creosote, also the five upper altars.

The pumps for the docks to have a discharge capacity equal to 40,000 gallons per minute each.

Dry dock builders are invited to submit plans and specifications with proposals for the entire construction and completion, in all respects, of one or both of the Timber Docks of the dimensions above specified. Proposals, plans and specifications are also invited, and will be considered, from dry dock builders for two Timber Docks of any length over and above 480 feet and not exceeding 500 feet (the dimensions otherwise to be the same as herein before stated), the cost of the increased length to be proportionate per lineal foot to the offer made for the docks of 480 feet length.

Bidders will make their plans and specifications full and clear, describing the kinds and qualities of materials proposed to be used.

D. B. HARMONY,
Chief of Bureau.

Bridge Proposals.

COUNTY CLERKS OFFICE,
LEAVENWORTH, Kan. May 1, 1887.

Notice is hereby given that sealed proposals will be received at this office up to 12 m. of Monday, June 1, 1887, for the building of two iron bridges, to-wit:

One iron bridge across Walnut Creek on Atchison and Tonganoxie Road, Alexander township.

One iron bridge across Five Mile Creek on De Soto Road, Delaware township, said bridges to be paid for when money is collected.

The above bridges to be built according to plans and specifications of the county engineer on file in county clerk's office.

Each bid must be accompanied by $50.00 or certified check or will not be entertained.

The board reserves the right to reject any or all bids.

By order of the board.

J. W. NIEHAUS,
County Clerk.

See proposals on page 21.

WATER, AND COMMERCIAL ANALYSES. LEDOUX & CO. Engineers, Metallurgists & Chemists. 10 CEDAR ST., New York City. Make expert investigations, Tests and analyses of all kinds, in the fields of Sanitary, Chemical and Electrical Engineering, assay ores and furnace products.

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To Water Works Contractors.

Sealed Tenders from companies on their plans, for the construction and maintenance of a system of water works for the **Town of Berlin,** Ontario, Can., will be received until Saturday June 3, 1887.

Proposals to state number (from 50 to 85) and annual rental of Fire Hydrants.

Water may be obtained from springs or driven wells.

The lowest nor any tenders not necessarily accepted.

Further information can be had by applying to ISRAEL D. BOWMAN, Town Clerk. 18-3t

To Bridge Builders.

SEALED PROPOSALS will be received by the undersigned at Taylorsville, Ky., until the 1st day of June, 1887, for the erection of a bridge across Brasher's creek, at Taylorsville, Ky., of steel, iron or wood, 266 feet long and 16 feet roadway, of three spans, two of 68 feet each and the other 140 feet. Stone work furnished. To be built as soon as practicable. The Commissioners reserve the right to reject any and all bids.

GEO. W. ANDERSON,
JOHN S. HOWARD,
JOS. B. COX,
Commissioners.

Sewer Notice.

NOTICE hereby given that bids will be received by the Chairman of the Sewer Committee, at the City Clerk's office, until 12 o'clock M., on May 28, 1887, for the furnishing of material, construction and completion of a part of East Main Street System, District No. 1, as provided for by Ordinance passed July 12, 1886, being 800 ft. of 4 ft. sewer and 3,250 ft. Plans, specifications and profile are on file at the Street Commissioner's office in said city. An approved bond of Five Hundred Dollars ($500) will be required to accompany each bid.

The Council reserves the right to reject any or all bids. By order of the City Council.

WM. ALLEN VEACH, City Clerk
H. G. KINGSBURY, Engineer.
Newark, O., April 28th, 1887.

The Fastest Driving on the **NEW CROTON AQUEDUCT** has been done with

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Shaft 18½.—May 25—June 25, 1886, 290 ft., 16 × 16 tunnel, $300 1st prize.
The only trials held in Aqueduct, all drills competing.
Shaft 15.—January 1887, 326 ft., 8 × 16 tunnel.

SEMI-MONTHLY RECORD.

Shaft 20.—January 15—February 1, 1887, 189 ft., 9 × 21 tunnel.

WEEKLY RECORDS.

Shaft 13.—Week ending December 12, 1885, 81 ft., 16 × 16 tunnel.
Shaft. 15.—Week ending January 22, 1887, 90 ft., 8 × 16 tunnel.
Shaft 15.—Week ending March 26, 1887, 102.1 ft., 9 × 17 tunnel.

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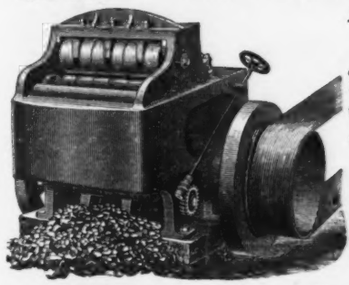

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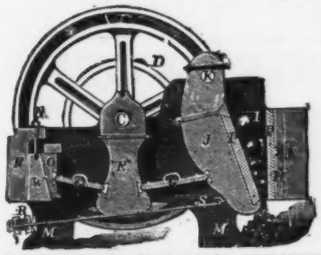

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23-N	209.1	15-S	147.8
22-N	197.5	14A-S	134.0
11A-N	185.8	15-N	129.0
4-N	182.4	19-N	119.0
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Average, 198.9 ft.		Average, 136.5 ft.	

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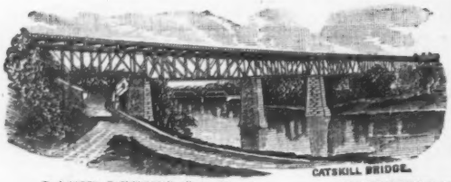
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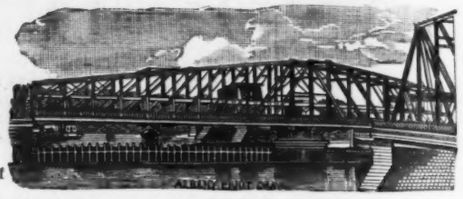

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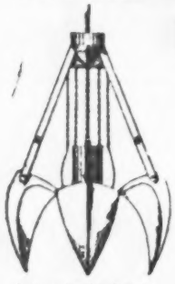
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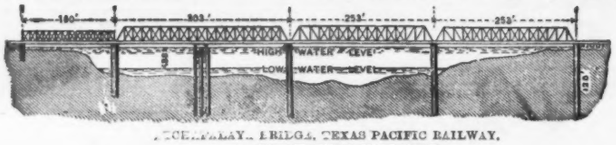

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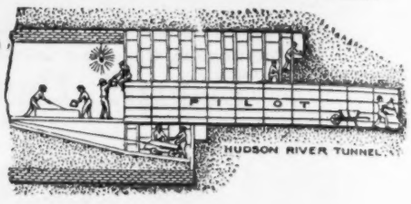

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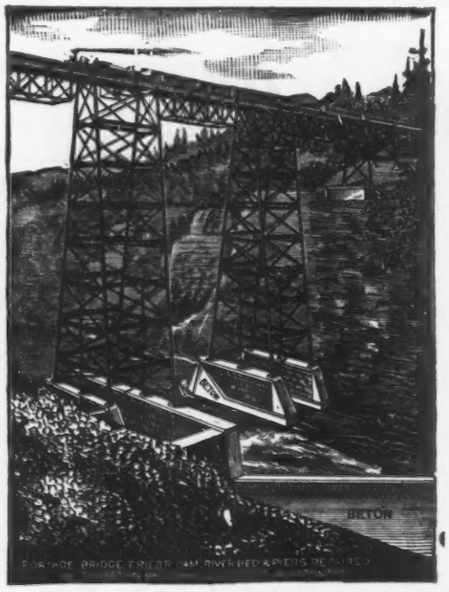

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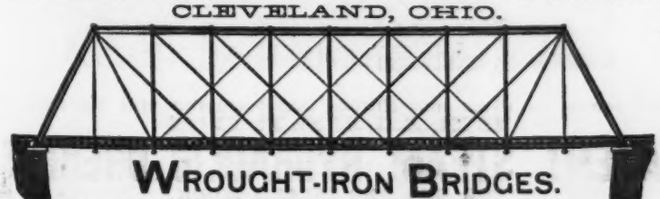

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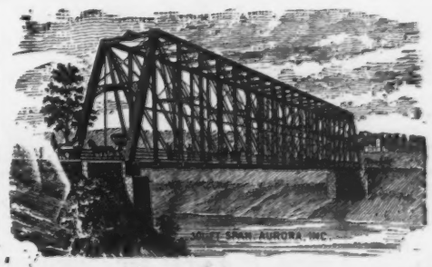

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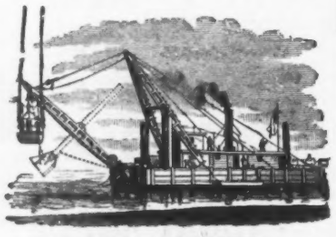

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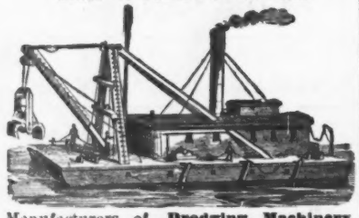

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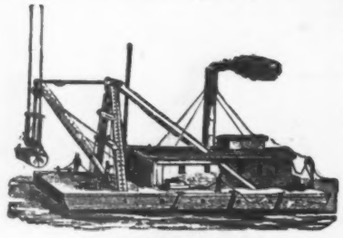

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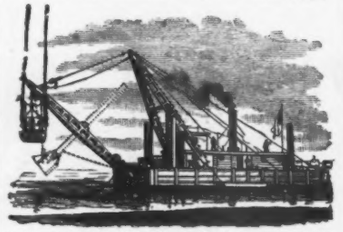

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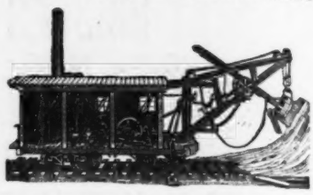

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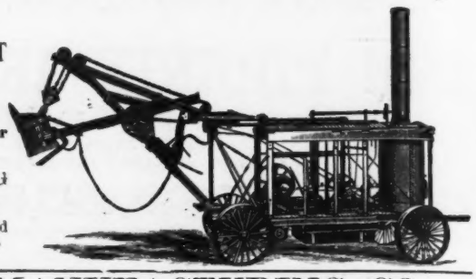

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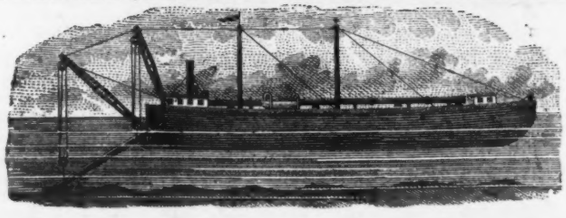

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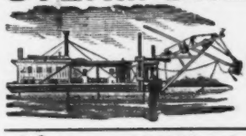

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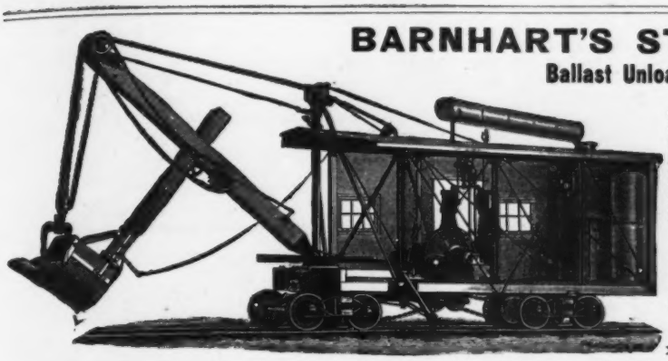

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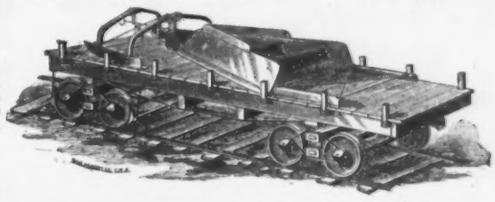

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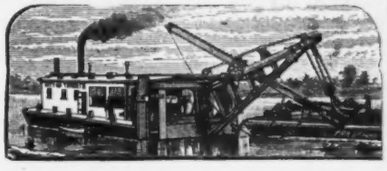

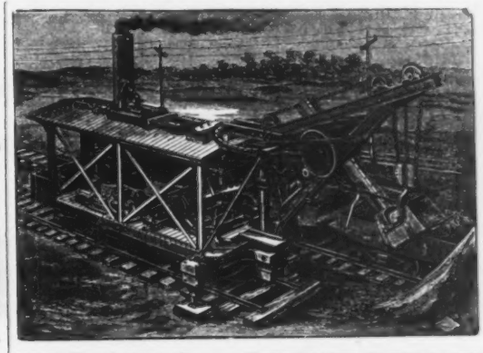

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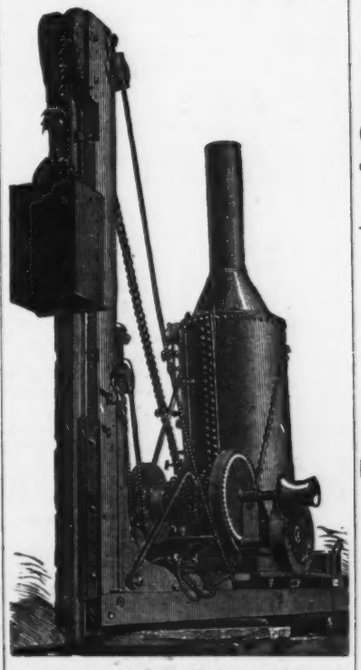

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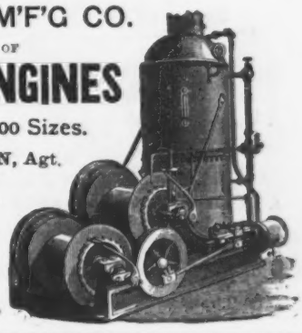

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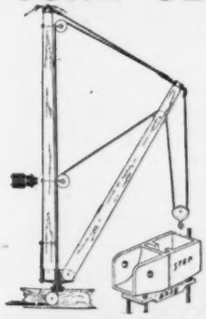

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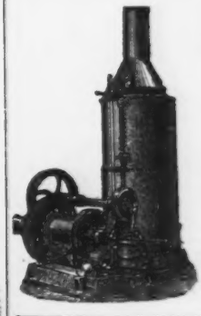

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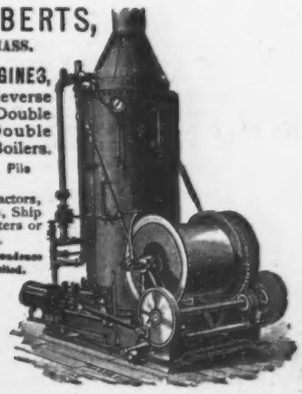

Third Issue ready, 1887. "*Statistical Tables of American Water Works.*" *Price*, $2.00 *Sent prepaid on receipt of price by* ENGINEERING NEWS, *Tribune Bdg. N. Y.*

BACK NUMBERS OF ENGINEERING NEWS. 1886.

We have at this date (May 14) — 45 separate weekly numbers of ENGINEERING NEWS for 1887 : of these we have only 2 or 3 copies of some, and as many as 50 of others : the papers on MUNICIPAL ENGINEERING are very nearly all included in this lot, and of themselves make about 30 numbers. Other special articles are as follows :

No. 1. Tunnel Accidents on the South Penna. R. R.
Approximate Estimate of Cost of Tunnel Excavation
Progress Record of Tunnels on So. Penna. R. R. from Commencement to End of Work.

No. 2. Surveys of the Coast of Holland.
Sections 12, 13, & 14 New Croton Aqueduct.
Bower-Barff Process for Protecting Iron.
German Cement Mfrs. against Spurious Cement.

No. 3. Steel. How shall we Test it?
English Tramways (Very Complete.)

No. 4. Progress on the Upper End New Croton Aqueduct.
Lifting a 40-inch Water Main.
Annual Meeting A. Soc. C. E.
Report of a Commission appointed to consider a general system of Drainage for the Valleys of the Mystic, Blackstone, & Charles Rivers, Mass.

No. 5. The Vyrnwy Masonry Dam.
Engineering in War Times.
Ventilation of Sewers.
Bids for Constructing Sections 12, 13, & 14 New Croton Aqueduct.

No. 6. Schuylkill River Bridge. B. & O. R. R.
Inland Navigations of Europe.

No. 7. Hawkesbury Bridge, New South Wales.
Base Line Measurements by the Steel Tape.
Graphic Determination of Stresses on Rivets in Plate Girders, (also in No. 10.)
Re-Organization of the Scientific Bureaus of the General Government.

No. 8. Proposed Harlem River Bridge. Second Prize Plan.
Drainage District and the Construction of Drainage Canals in Ills.
Physical Theory of the Steam Engine and Boiler.
Reports on Quaker Bridge Dam and Reservoir.

No. 9. Reports on Quaker Bridge Dam and Reservoir.
Harlem River Bridge. First Prize Plan.
Physical Theory of the Steam Engine and Boiler.

No. 10. Statistics of Street Railroads of San Francisco.
Examination of Water for Micro Organisms.
Topographical Models or Relief Maps.
Dredging Apparatus for Use in Shaft Sinking.
Eachus & Maignens System of Treating Sewer Gas.

No. 11. Road Improvement.
Automatic Sluices, with either Surface or Delivery Constant.
Some Notes on Different Systems of Water Supply.
Relative Safety of Travel over Asphalt and Stone Pavements.
The Winooski (Vt.) Bridge.

No. 12. Rail Joints, Rails and Sleepers.
Ceramité as Paving Material.

No. 15. The Proposed Harlem Bridge. (Accepted Design.)
Manufacture of Fire Brick at Mt. Savage, Md.
Apparatus for Measuring the Force of Explosives.
Water Pipe Scraper.
The Re-Location of Old Land Lines.
Paper on Evaporation, by Desmond Fitzgerald.
Experiments with London Sewage.

No. 16. The Severn Tunnel.
The Value of Water Meters.
An Important Contract Decision (Central R. R. of N. J. *vs.* Vanderbilt & Hopkins.
The Use of Cement Pipe for Sewers.
Fatal Accidents in Coal Mines.

No. 17. Road Paving Material.
Metal Railway Sleepers.
A Handy Curve Protractor.
Cleaning Cities by Railroad.
Gravel Roads.
Portable Bridges.

No. 18. A New Method of Sewer Building.
Shrinkage of Earthwork.
Piping for Natural Gas.
Water Ways of Northern Illinois.
Testing Cement.

No. 19. Shrinkage of Earthwork.
The Hawkesbury Bridge. Competitive Plans.

No. 20. Davis Island Dam. Ohio River.
A General Distance-Meter.
Novel Cement Testing Machine.
Sand as a Foundation. (Also No. 22.)

No. 21. Standard Timber Box Culverts. C. M. & St. P. R. R.
The Railroad from Blankenburg to Janne. Abt System Rack R. R.
Railways with steep Gradients.
Automatic Lock Gate.
Specifications for 16th St. Viaduct. Omaha, Neb.

No. 22. Jersey City Passsenger Station. Erie Railway.
Sand as a Foundation.
Miner's Inch of Water.

No. 23. The Wetzman Retaining Dam.
Lighthouse Lantern. Bishop's Rock.
The Prismoidal Formula.

No. 24. Collection, Storage, Purification and Examination of Water (completed in one Number, and very valuable.)

No. 26. New England Water-Works Association.
Cumulative Vibrations in Railroad Bridges.

The above 23 Numbers complete all that we have of Volume XV. January to June, 1886. *There are Indexes.* The Municipal Engineering of Boston and Providence, is given in these Numbers, complete all but 2 Numbers in Vol. XVI. We will sell the above Numbers at 8 cents each or $1.50 for the set. We cannot make up more than 2 or 3 sets of 23 Numbers. Parties will do well to order at once, as we positively will not keep a single back Number later than June 1st, Shelf-room in New York is valuable.

No. 28. July 10, 1886. Vol. XVI.
Canadian Government Surveys.
The River Seine. (Also in Nos. 29 & 31.)
English and American Railroads Compared.

No. 29. Harlem River Draw Bridge, Suburban Rapid Transit Railroad.
Earthwork Computation by the Prismoidal Formula.
One Year of Engineering Progress.

No. 31. Harlem River Draw Bridge (Specifications).
Harlem River Bridge (Vaux and Bradford's Plan).
Removing the Shallow Flowage from the Sudbury River.

No. 32. Report of Supervisory Board of Commissioners of the New York Municipal Civil Service (Giving Examination Papers).
Pile Driving.
Engineers Surveying Instruments. The Plane Table.
The Spongilla in Main Pipes.
High Service Engine. St. Louis Water-Works Specifications.

No. 33. Low Pressure Water Supply.
Canadian Government Surveys.
High Bridge Building.

No. 34. Rainfall, The Amount Available for Water Supply.
The Tower Bridge, London, Eng.
Municipal and Sanitary Engineering in the City of London, Eng. and (also in No. 35).
Engineer's Surveying Instruments. The Transit.

No. 35. The New Channel from Rotterdam to the North Sea.
Thermometer Scales.
Coal Tar Products.

No. 36. Capacity of Tile Drains and Open Ditch.
Trigonometrical Survey of India (also in No. 37).
Water Power of the U. S.

No. 37. Engineers Surveying Instruments. Verniers.
Wrought Iron vs Cast Iron Water Pipes.
Sewers and Sewage Disposal of Providence. R. I.
The Electrical Subways.
Cryptography: Beaufort System (also No. 40.)

No. 38. Canadian Government Surveys.
Proportioning of Culverts.
Cleaning Greasy Tracing Cloth, (also in No. 40.)
Stand Pipes. (also in No. 44.)
Brick Pavements for Streets.

No. 40. Life Time of Pumping Machinery.
Proper Dimensions of Chimneys.

No. 41. The Cost of Raising small quantities of Water by Steam Pumps
A few facts about Steam Boilers.
The Underground Wire Problem.
Engineers Surveying Instruments. Practical Hints, etc.
Cylinder Capacity and Cost of Steam Engines.

No. 42. New Market St. Bridge in Philadelphia.
Importance of Ballast in Maintenance of Permanent Way.
Calorific Value of American Coals.

No. 43. Influence of Ground Water on Health.
Steam for Engine Use.

No. 44. Widening a Tunnel on the S. V. R. R.
Gate House of New Croton Aqueduct.
Design of Girder Bridges.
Steam Expansion and Weight of Engines and Boilers.
Sugar as an Ingredient in Mortar.
Engineering Features of Illinois Drainage.

No. 45. High Duty Pumping Engines.
The Weehawken Water Tower.
Sewers of Paris.
British Ordnance Survey.
Lighting the Statue of Liberty.
On the Proper Horse Power Rating of Steam Engines.

No. 46. Large Retaining Walls in France.
Engineers Surveying Instrument. The Level.
Performance of Stationary Steam Engines.
The Sandusky Stand Pipe.
German Specifications for Standard Portland Cement Tests.

No. 47. Triangulation and Measurement of the Forth Bridge.
The Statue of Liberty.
Report of the Executive Board of Rochester, N. Y.
Philadelphia Electric Pneumatic System.

No. 48. Heliography, or the Active Copying of Engineering Drawings.
Louisville & New Albany Bridge.
Membership of the American Soc. C. E.
Loss of Condensation of Steam in Engine Cylinders.
Quick Triangulation.
Report of the Chemist of the Engineer Dept. of Washington, D. C.
Lead Furnace for Pipe Layers.

No. 49. Recent Improvements in Dredging Machinery.
Engineers Surveying Instruments. The Level.
Natural Gas and the Pipe used in its Service.
Irrigation.
Friction of New Condensing Steam Engines.

No. 50. Engine Foundations in Asphaltic Masonry,
Roller Curtain Head Gate.
Directions for Making Drawings for Reproduction.
Efficiency of Ventilating Fans and Blowers.

No. 51. Some Notes on the Working Stress of Iron & Steel.
Wrought Iron Conduit Pipes.
Russian Rules for the Use of Steel in Construction.
Water Pipes.
Value of Feed Water Heaters.
One Years' Progress on New Croton Aqueduct.

There are 22 Nos. of Vol. XVI. Also Index if wanted. Municipal Engineering of Washington, D. C. is published in these Nos., and Philadelphia is commenced in No. 51. "Accidents in Mines" is completed. The above Index to articles is of course but imperfect: it would be a poor issue which of itself was not worth the price we ask for it. Price per No. 8 cents or $1.50 for the set. Sent postpaid. The Nos. can be cut up and pasted into scrap books. For this purpose 2 sets will be sent to same address for $4.00. A set means one of each No. on hand *at time of order* and necessarily must grow smaller each week. Address, ENGINEERING NEWS PUBLISHING CO.
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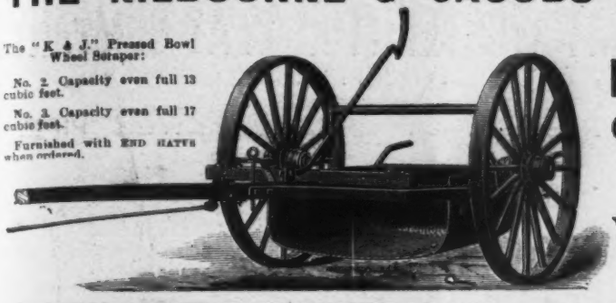

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No. 1. Cap. cubic feet.
" 2. " 5 " "
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Pipe Laying at Sheboygan, Wis.

MUNCIE, IND., May 25, 1887.

SEALED PROPOSALS will be received at the office of W. S. KUHN, Muncie, Indiana, until noon, **May 24th, 1887**, for laying at **Sheboygan, Wis., 22,000** feet 6 inch, **16,000** feet each of 8 inch, 10 inch, 12 inch and **4,000** feet each of 16 inch and 18 inch, Cast-iron pipe all 6 foot cover.

The right to reject any or all bids is reserved. W. S. KUHN, Gen. Manager.

SEALED PROPOSALS.

Iron Bolts, Nuts and Washers.

Notice is hereby given that sealed proposals will be received by the city of San Diego, Cal. up to the hour of 7 o'clock P. M., on the 27th. day of May, 1887, at the room of the Board of Trustees of said city, for Iron Bolts, Nuts and Washers, as described in the following specifications, to wit:—

1,250 bolts of best wrought-iron, three-fourths of an inch in diameter, with heads three-fourths of an inch thick and 2 inches square; nuts of the same size. Length of bolt clear of head, 14¼ inches; thread cut 2½ inches from end of bolt.

Also, 2,500 washers, one-eighth of an inch thick, 2½ inches in diameter, with seven-eighths of an inch hole in the center.

The above to be delivered to the Resident Engineer of the sewerage work in San Diego on or before the 1st day of August, 1887.

To be in all respects in conformity with the above specification and so certified by the Resident Engineer of Sewerage of San Diego.

Bidders will specify the sum total for which they will deliver the said bolts, nuts, and washers, as above.

All proposals offered shall be accompanied by a check, payable to the order of the president of the Board of Trustees of said city, certified by a responsible bank, which shall not be less than 5 per cent. of the aggregate of the proposal, or by a bond for the said amount, with condition that the bidder will carry out the terms of his bid, signed by the bidder and two good sureties, who shall justify before an officer competent to administer oaths, in double said amount, over and above all statutory exemption.

The Board of Trustees of said city reserve the right to reject any and all bids.

Dated April 21, 1887.

M. D. HAMILTON,

President of the Board of Trustees of the city of San Diego, California.

Attest: H. T. CHRISTIAN, Clerk of the city of San Diego, Cal., and clerk of said board, by J. A. THOMAS, Deputy Clerk of said city and clerk of said board.

SEALED PROPOSALS.

Woodwork Construction, Sewage Reservoir.

Notice is hereby given that sealed proposals will be received by the city of San Diego, Cal., up to the hour of 7 o'clock P. M., on the 27th day of May, 1887, at the room of the Board of Trustees of said city, for woodwork construction, sewage reservoir, as described in the following specifications, to wit:—

The creosoted lumber for this work will be furnished by the city of San Diego, on or before the 1st day of August, 1887, or as soon thereafter as practicable. Work must be begun as soon as 50 piles are delivered.

The contractor will drive the piles to the depth required by the Resident Engineer, square with the work, and on true lines as shown by the plans.

The piles will be in two rows, 10 feet 6 inches apart in the clear, their opposite faces being sheeted with three-inch plank, held in place below the level of low water in such manner as the engineer may indicate, and above low water by nailing with seven-inch cut spikes, two such spikes being driven for each pile or four where joints occur. Piles will be 6 feet on center.

The pairs of piles will be tied together by three-inch by twelve-inch planks of proper length, bolted to the piles as shown on the plans, the plank facing to the cut around these ties.

After the space between the planking shall have been duly filled with earth, the top is to be floored with three-inch planks nailed to the top row of cross ties with seven-inch spikes as above. This top planking is to extend to the full length of the cross ties, covering the tops of the piles, and the angle between the flooring and the side walls is to be closed with three-inch stuff set on a slope as shown by the plans.

The contractor will furnish all staging, floats and other materials and utensils required for the complete performance of the work, all of which is to be done under the direction and to the satisfaction of the Resident Engineer of Sewerage of San Diego, and so certified by him.

Bidders will specify the sum total for which they will construct the work as above specified.

All proposals offered shall be accompanied by a check, payable to the order of the president of the Board of Trustees of said city, certified by a responsible bank, which shall not be less than 5 per cent. of the aggregate of the proposal, or by a bond for the said amount, with condition that the bidder will carry out the terms of his bid, signed by the bidder and two good sureties, who shall justify before an officer competent to administer oaths in double said amount over and above all statutory exemption.

The Board of Trustees of said city reserve the right to reject any and all bids.

Dated April 21, 1887.

M. D. HAMILTON,

President of the Board of Trustees of the city of San Diego, California.

Attest: H. T. CHRISTIAN, City Clerk of the city of San Diego, Cal., and Clerk of said Board of Trustees.

By J. A. THOMAS, Deputy Clerk of said city and Clerk of said Board.

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Wanted.—Index and Title Page for Jan. to July 1885. ENGINEERING NEWS January 17 and 24; May 2 and October 31. Will pay 10 cents a number. ENGINEERING NEWS.

Wanted.—A first class man who understands track laying and alignment thoroughly, who can give good references for outside work in connection with R. R. service. Address JOHN M. BUTLER, Pres., 114 So. 3d St., Philadelphia, Pa. 18-3t

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Wanted.—Position as transitman, leveller or assistant draughtsman. Address "Tangent" Care Engineering News. 19-3t

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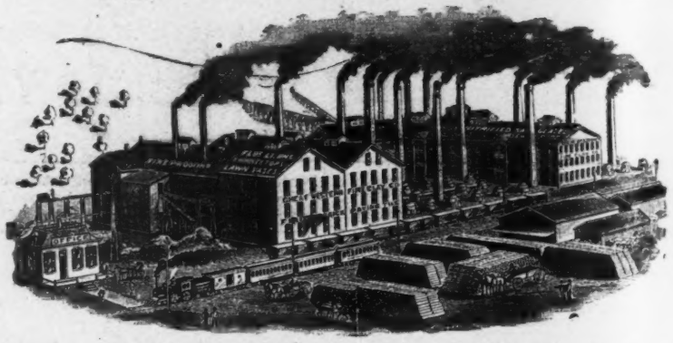

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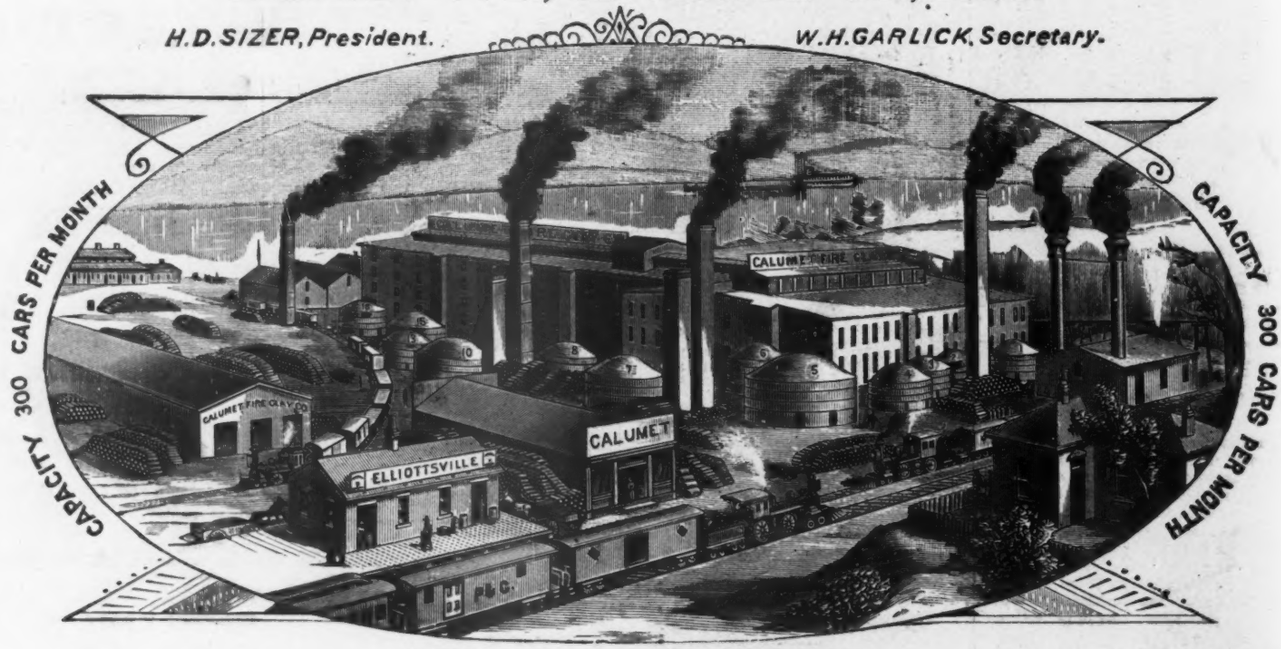

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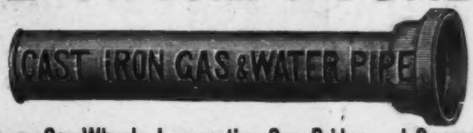
Manufacturers of 

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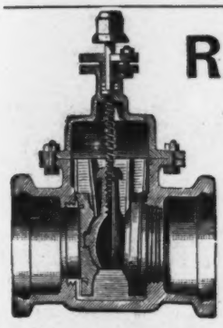

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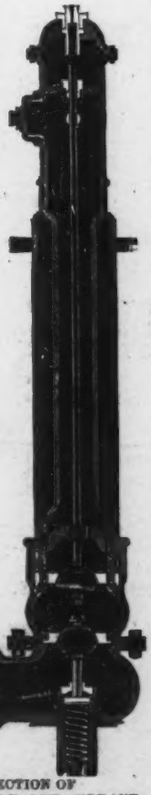

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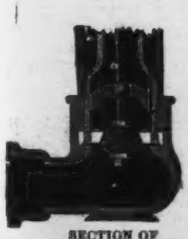

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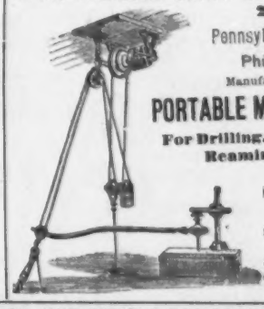

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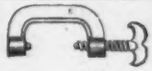
WATKINS' PATENT 

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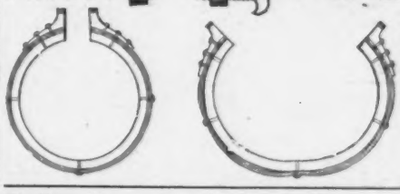

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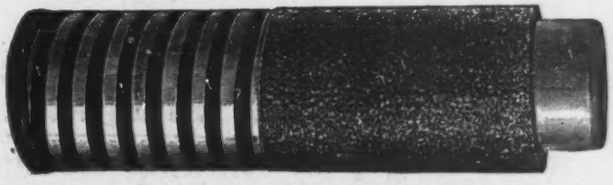

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DRAWING MATERIAL OF ALL KINDS.
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THE BARBER ASPHALT PAVING COMPANY.
GENUINE TRINIDAD THE BARBER ASPHALT PAVING CO. PATENTS ASPHALT TRADE MARK

The extent of pavements laid by this Company, prior to Jan. 1, 1887, is as follows:

Washington	568,088	Square yards.
Buffalo	612,270	" "
Omaha	239,952	" "
New Orleans	129,333	" "
St. Louis	82,309	" "
Philadelphia	82,097	" "
Louisville	46,940	" "
Chicago	46,814	" "
Baltimore	31,188	" "
Boston	25,931	" "
Other Cities	135,480	" "
Total	2,020,402 yards	

or the equivalent of about 132 miles of 26 feet roadway.

ITS ADVANTAGES.
DURABILITY,
SMOOTHNESS,
HEALTH,
SAFETY,
NOISELESSNESS,
POPULARITY,
CHEAPNESS.

It is the only pavement which in this country can to-day show 100 miles of surface in first class order. It is the standard pavement of America.

It will save 50 to 75 per cent. of the cost of transporting passengers and goods in any city.
It will save 50 to 75 per cent. of repairs to vehicles.
It saves human nerves and health, and adds to the comfort of every person who uses a carriage.

LIST OF OFFICES
New York, 280 Broadway; Philadelphia, 451 North 30th Street; Boston, 101 Milk Street, Buffalo, Chapin Block; Chicago, 184 Dearborn Street; Omaha, 215 14th Street; Louisville, 6th and Lee Street; St. Louis, 5th and Olive Sts, New Orleans, 81 St. Charles Street; London 2 Crosby Square, E. C.; Paris, 6 Boulevard de Strasbourg; Berlin, 35 Maassen Strasse.

For plans and estimates apply to the general offices of the Barber Asphalt Paving Company.
A. L. BARBER, President, Le Droit Building, Washington, D. C.
F. V. GREENE, Vice President, Stewart Building, 280 Broadway, New York